

how to get  
extreme heat  
with  
pinpoint  
control:

# Electric Furnaces

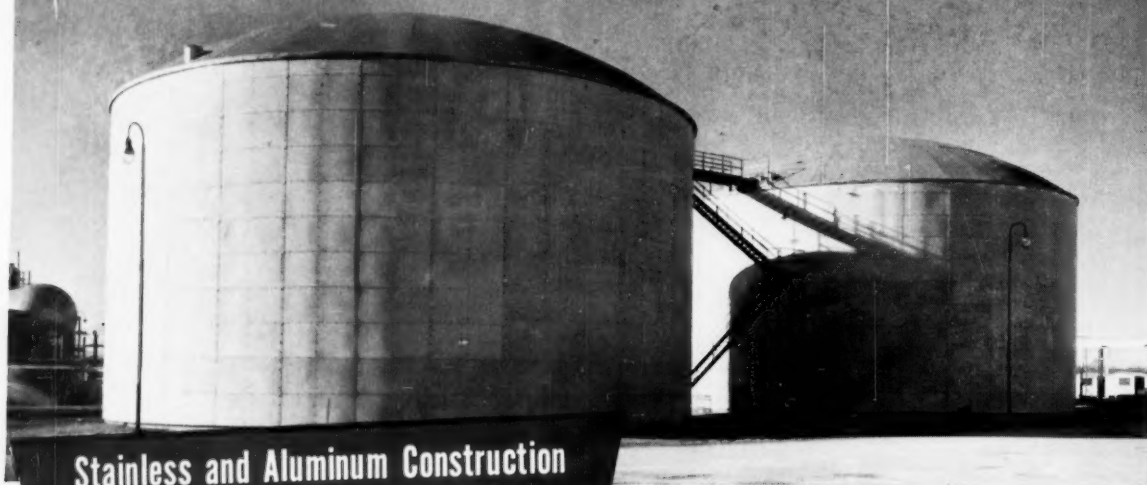
NEW IDEAS ABOUT ELECTRIC FURNACES  
ALL ABOUT CONTROL VALVES  
HOW TO AVOID ONE BIDDING PITFALL

SEE  
PAGE  
FIVE

**At SOHIO Petrochemical Plant:**



**-Built tanks store 83% ammonium nitrate**

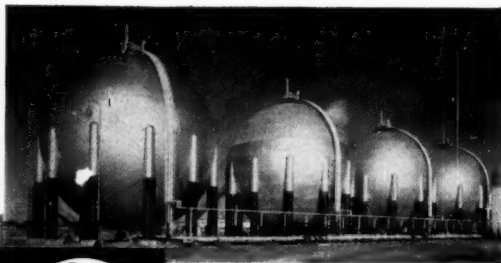


**Stainless and Aluminum Construction  
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for ammonia and derivatives**

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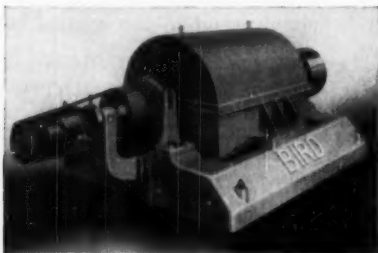


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MARCH 9, 1959

Vol. 66, No. 5

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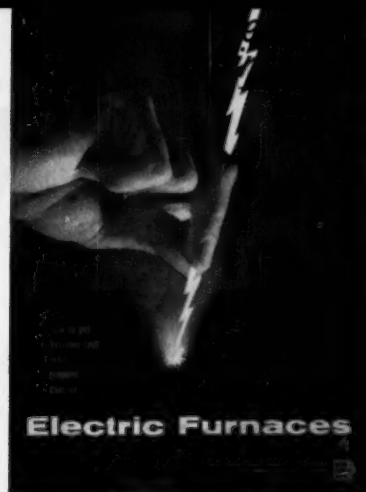
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FIFTH OF TWENTY-SIX 1959 ISSUES

5/26

## Electric furnaces are process equipment

The three types of furnaces—resistance, arc and induction—are being used in more and more chemical processes. They're no longer tools of limited application. See how you can reach extremely high temperatures. And control them in a very small space. (p. 133)

## How to get the best from control valves

Here's the real lowdown on all kinds of control valves. This introductory article is the first in a new CE series that can update your know-how. It's a thorough review of today's concepts, materials and all the other basics behind satisfactory control valve operation. (p. 137)

## Is your flowmeter as accurate as you think?

The kind of scale on your meter is fixed by the kind of measuring element you're using. Now you can let the accuracy you need help pick your meters. And you can get a truer picture of the accuracy of the readings from meters you're using now. (p. 147)

## Watch this pitfall in competitive bidding

There's a danger when you're bidding to supply engineering services or equipment. How do you keep the purchaser from using or giving away your ideas? A new protective trend in ethics is evident. But meanwhile, see what the courts have to say. (p. 158)

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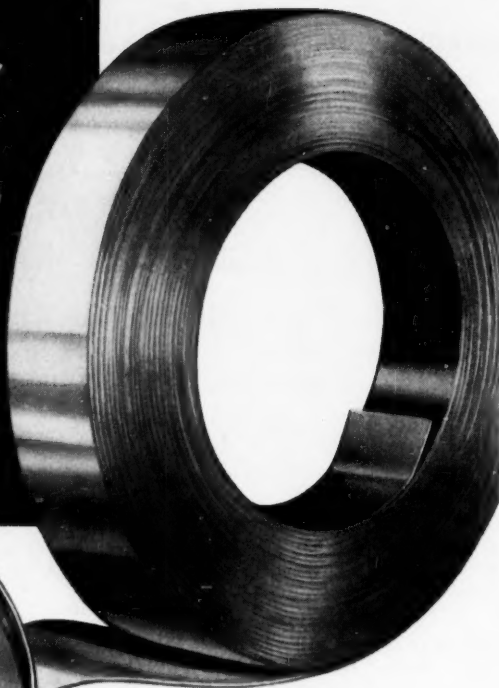
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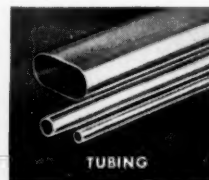
DOUBLE CLAD STRIP



OVERLAY



WIRE

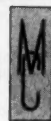


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# Chemical Engineering

MARCH 9, 1959

Vol. 66 No. 5

Edited for the engineers who develop, design, build, operate, maintain and manage chemical operations of all types. More engineers subscribe to CE than to any other magazine in the field. Print order of this issue: 49,022.

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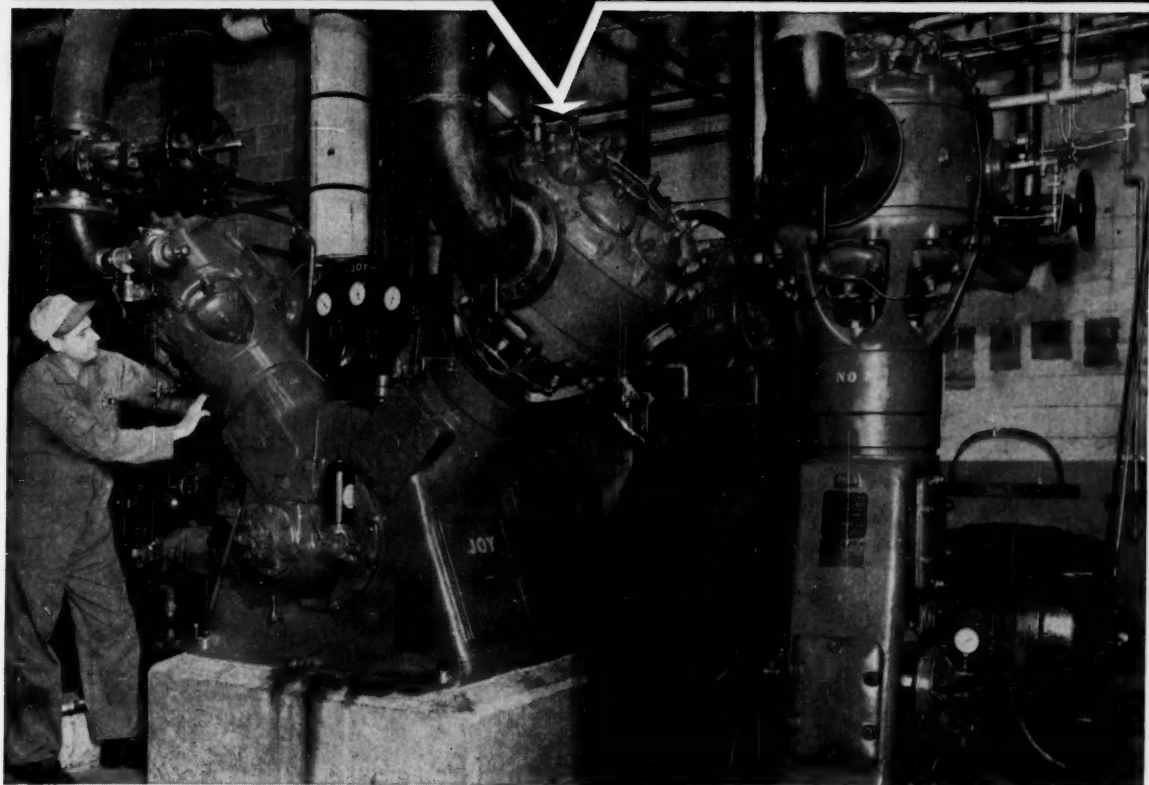
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F-8

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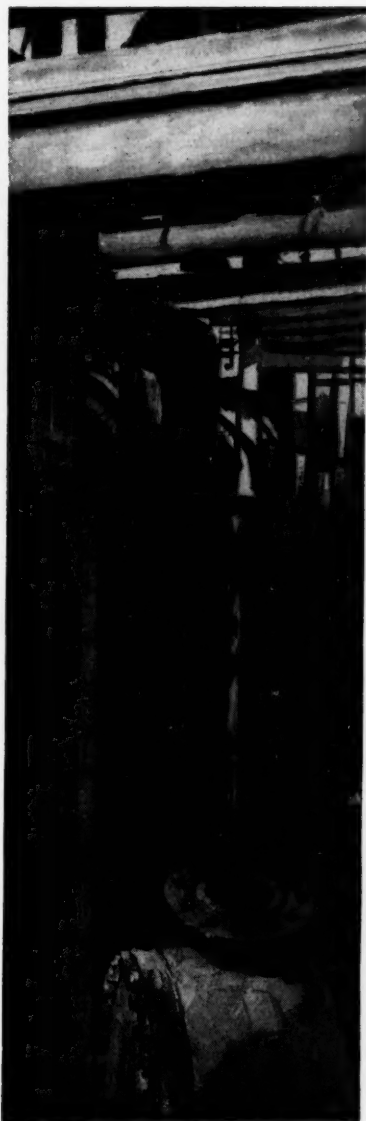
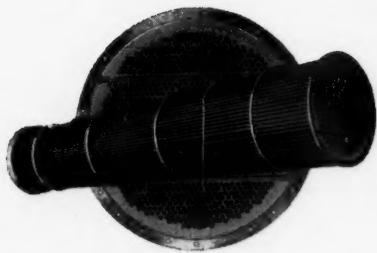
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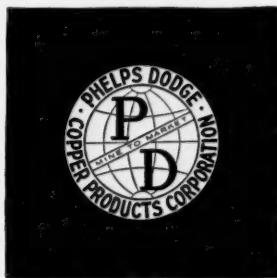
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*Glas-Col announces  
the Ultimate in  
Heating Tapes*

## ...the New GLAS-COL Nichrome Ribbon Heating Tapes

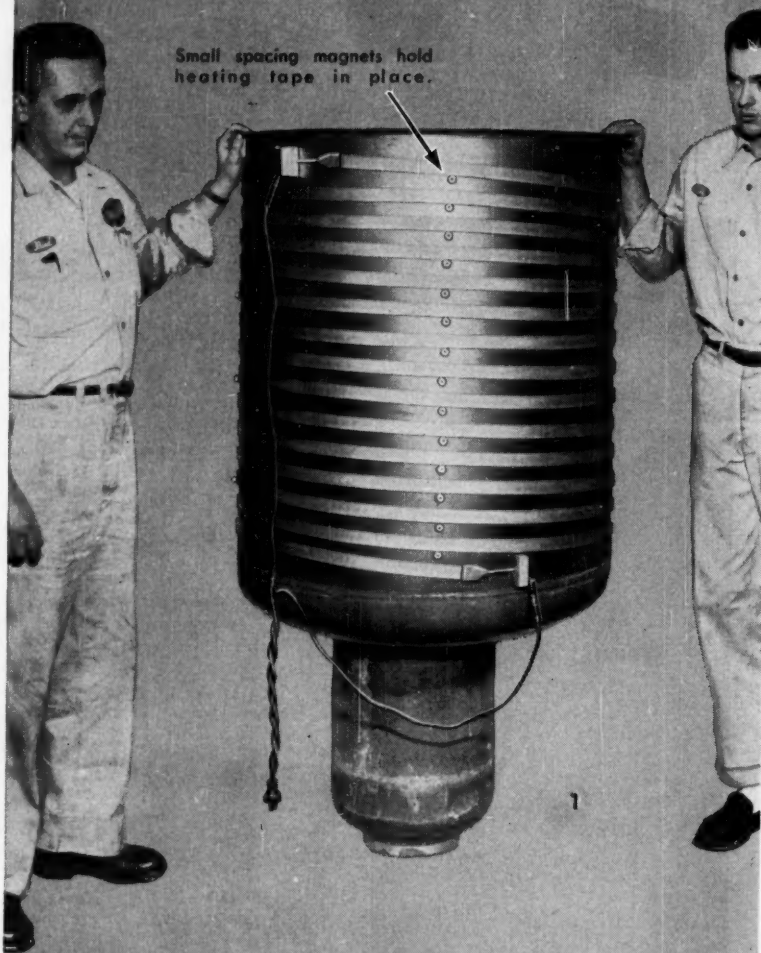
Patents Pending

*They won't burn out..  
they're safe..  
they're highly flexible*

### How are the new Glas-Col Heating Tapes better?

The new Glas-Col heating tapes represent the most important design improvement in heating tapes within the last quarter century. Fragile, fine-wire, easily breakable heating elements that are woven into conventional tapes are a thing of the past. Instead, the heating element in the new Glas-Col tapes consists of a thin, but strong Nichrome ribbon. Covering is of glass braid, and silicone rubber . . . which is extremely tough and durable.

Small spacing magnets hold heating tape in place.



Just published! Ask for your copy of four-page Technical Bulletin 4-B which tells the complete story of Glas-Col Nichrome Ribbon Heating Tapes.

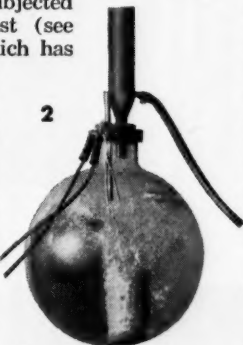


## What are some of the advantages offered by Glas-Col heating tapes?

**Glas-Col heating tapes will not burn out.** They're tested at 1000 volts for electrical breakdown. They will give years of service if the silicone rubber covering is not subjected to temperatures above 480°F. The Nichrome heating element will not burn out even when used far beyond the assigned wattages.

**They're available in long lengths . . .** Glas-Col heating tapes are ideal for applications calling for extremely long lengths . . . many hundreds of feet. For the longer lengths you merely select a heating tape which is wider or thicker or both. Tapes 2" wide (or more) can be furnished. In spite of the long lengths, Glas-Col Nichrome Ribbon Heating Tapes furnish adequate watts per foot. For example, a Glas-Col 2" tape, 224 feet long, will give 16,900 watts at 440 volts, which is equivalent to 75 watts per foot.

**They're waterproof . . . weatherproof.** The presence of water or other fluids cannot cause burnouts. To definitely prove its waterproof characteristics, a 12-foot length of 1/2" wide Glas-Col heating tape was subjected to an extremely severe test (see picture #2). The tape, which has an arbitrary rating of 600 watts, 70 volts, was wrapped around a 3" diameter aluminum cylinder and used as an immersion heater for the boiling of water (in spite of the fact that it was not designed for use as an immersion heater). The water was refluxed continuously for four days in a 50-liter flask at an incredible power input of more than 5000 watts. Result: no burnout, no deterioration whatsoever.



2  
Glas-Col heating tape is subjected to boiling water test for four days.

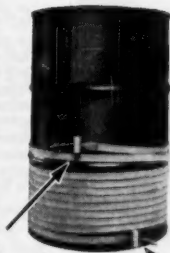
**They're easy to install.** For drums and similar steel tanks, the tape is simply wound around the area to be heated. Small, but powerful, permanent magnets hold each end of the tape (see picture #3). For applications where tape must be spaced, and must cover the full length of the receptacle, small spacing magnets are used, as shown in photo #1 on the adjoining page.

If the installation is to be permanent, or if the tank is quite large, the turns of the tape can be held in place by a simple spacing band (see picture #4).

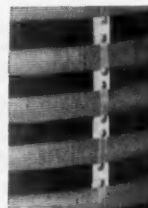
Glas-Col heating tapes are particularly suitable for heating pipelines. Costs of labor for installation are quite low. Tapes are merely strung lengthwise (one tape for small pipes . . . two tapes for diameters over 3"), then covered with insulation. Spiral wrapping, or the use of a large number of short tapes, (both of which would involve expensive labor) is not necessary.

**They're safe.** Glas-Col heating tapes have no exposure points where fine wires protrude from the tape.

**They're flexible.** Although the silicone rubber covering is rugged and tough, Glas-Col heating tapes are nevertheless extremely flexible and easy to handle. Total thickness is only 1/16".



3  
Small, powerful, permanent magnets hold opposite ends of heating tapes.



4  
Close-up view shows how simple spacing bands hold tape in place where installation is to be permanent.

Glas-Col Apparatus Company, Dept. CR, 711 Hulman Street, Terre Haute, Indiana

U. S. Patents  
2,282,078  
2,739,220  
2,231,506 and  
2,739,221

### GLAS-COL Heating Tapes



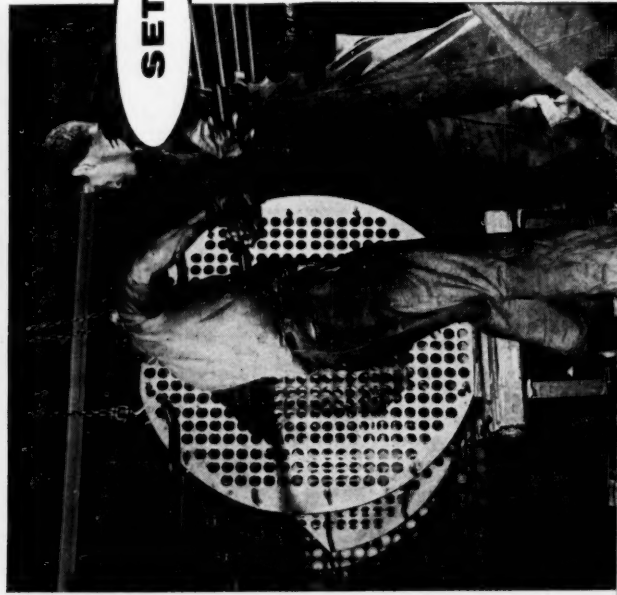
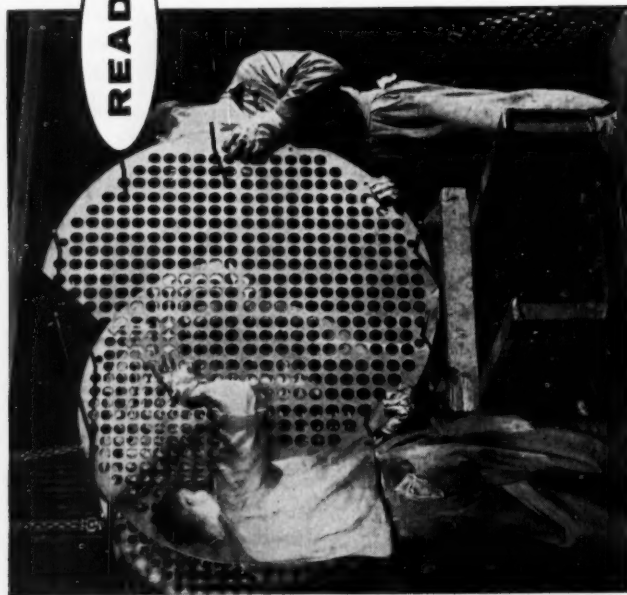
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**PRICES**—Glas-Col Nichrome Ribbon Heating Tapes can be furnished in ANY LENGTH AT NO EXTRA COST. This table tells the story.

Glas-Col, under no circumstances, compromises with quality. A much cheaper tape could be produced . . . but it would not last.

Width	Cost per foot	Cost for finishing ends and fitting with plugs and heater cord	. . . OR if you desire standard lengths (completely finished with plugs and cords)	
1/4"	\$0.80	\$7.00	\$11.80 (6 ft., 140 w., 35 v.)	\$15.00 (10 ft., 250 w., 60 v.)
1/2"	1.40	10.00	26.00 (12 ft., 600 w., 70 v.)	38.00 (20 ft., 930 w., 115 v.)
1"	2.75	10.00	90.00 (30 ft., 1650 w., 115 v.)	175.00 (60 ft., 3300 w., 220 v.)

(1" tape also available in 120 ft length: \$340.00)



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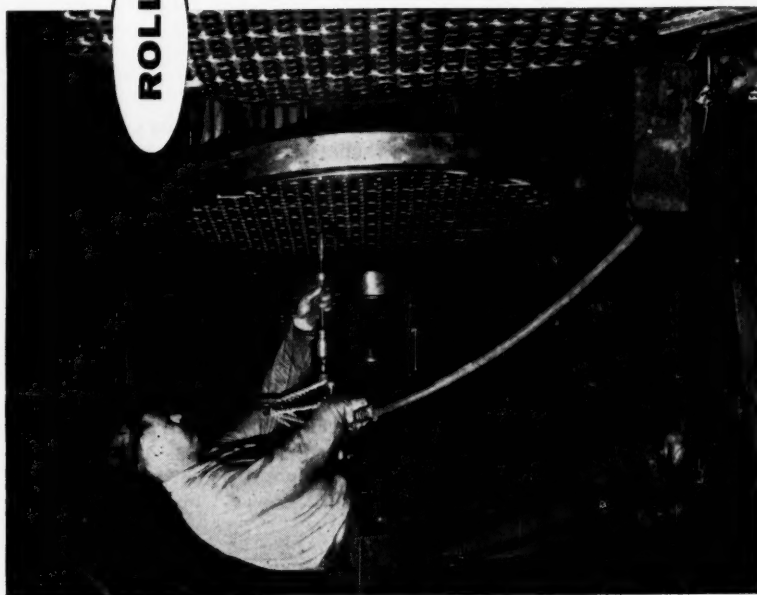
FARROWTEST, an eddy-current nondestructive test, is offered as an alternative to other less positive tests. To get the facts first-hand, call your Republic representative. Or send coupon today.

FARROWTEST REJECT TABLE

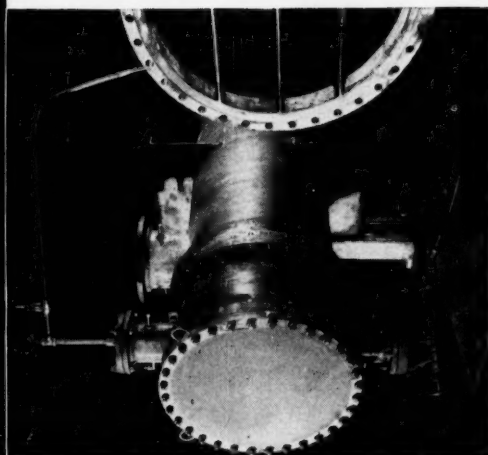
Wall Thickness	Minor Dimension of the Defect (Length or Depth)	Length X Depth Area in Square Inches
20 ga.	.006"	.0025"
18 ga.	.006"	.003"
16 ga.	12½% of Wall	.003"
14 and 13 ga.	12½% of Wall	.004"
12 ga. and heavier	12½% of Wall	.005"

FARROWTEST detects and rejects not only tubing containing defects which completely penetrate the wall; but also tubing with defects equal to, or greater than, those shown in this table. Where required, sensitivity of FARROWTEST equipment can be calibrated to reject defects of lesser specified area than shown in table, at extra cost.

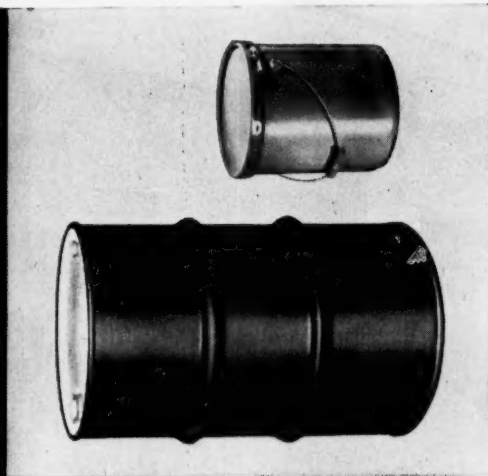




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**REPUBLIC ALLOY STUDS AND HIGH CARBON HEX NUTS** go hand in hand in serving the petroleum processing industries. They withstand major stress imposed on a wide variety of equipment. Clean accurate threads provide high strength and wear resistance, plus ease of assembly and disassembly required where equipment maintenance calls for it. Republic has fasteners to meet every application. Send coupon today.



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*World's Widest Range  
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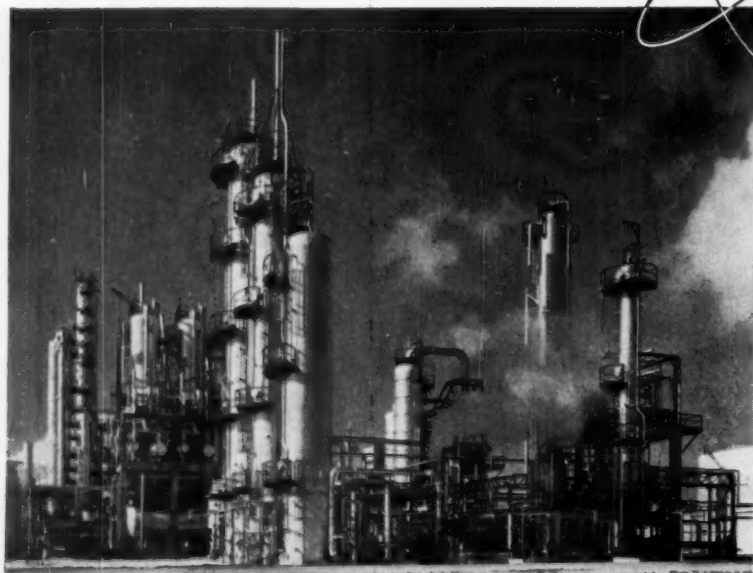
Please send additional information on the following:

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- ☐ Alloy Studs, High Carbon Hex Nuts
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- ☐ Republic Containers

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Company \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_



Photos by Robert Yarnall Richie



Designed, engineered and constructed by The Lummus Company, this giant petrochemical complex at Lake Charles, La., has three separate control rooms. The compressor and boiler unit is controlled by 38 Microsen control loops. 141 other loops measure variables to control ethylene processing, and 75 more control the ethylene oxide-glycol unit. Kybernetes data read-out equipment is integrated with Microsen instruments in one of the control rooms.

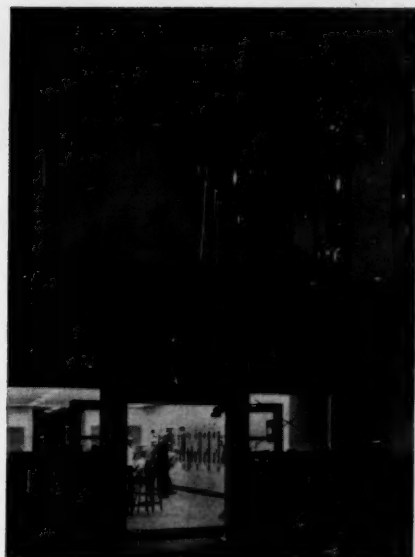


**Over 250 Microsen® loops**

**automate processes at**

**Petroleum Chemicals, Inc.**

**and Calcasieu Chemical Corp.**



**Microsen Electronic Process Instrumentation** measures and controls temperature, pressure, flow, and liquid level in this new \$80,000,000 installation. Microsen, the DC control system pioneered by Manning, Maxwell & Moore, Inc., was selected for quality of control and ease of installation.

Standard Microsen instruments are used in cascading. By adding ratio amplification in the output of master Controllers, special variable cascade units are created.

The process boiler installation is unique in the use of electronic instrumentation to control both air and gas supply. A special bipolar accelerating amplifier provides zero output under stable process conditions for the three-element feed-water boiler controls.

If a process upset occurs, the amplifier increases output in the indicated direction to correct the deviation. Amplifier output then decays to zero. Decay time is continuously adjustable within a range of .05 to 5.0 seconds.

Field wiring from Transmitters and Valve Positioners is carried in explosion-proof conduit which terminates in ducts at the rear of the panels in each control room. Wiring from ducts to panel instruments is covered with flexible rubber.

Microsen Electronic Process Controls assure permanent savings. They instantly transmit accurate measurements over long distances — assure process stability and efficiency. The DC signal (1.0 to 5.0 ma) is compatible with practically all data handling, telemetering and computing systems, and with process stream analyzers being developed. Microsen design flexibility anticipates ever-changing needs in process control.

Be certain of closer process control. Step up product quality and quantity. For new plant, new process or revamped old process, automate with the Microsen Electronic System. Learn how profitable it can be. Write for information or call in one of our sales engineers.



**MICROSEN ELECTRONIC CONTROLS**

**A product of**

**MANNING, MAXWELL & MOORE, INC.**

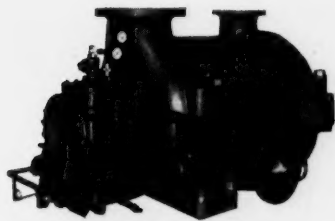
*Consolidated Ashcroft Hancock Division • Stratford, Connecticut  
In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario*



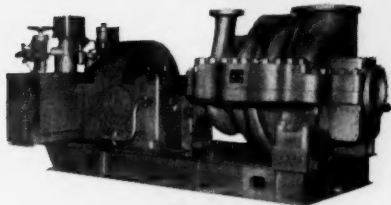


*John L. Parris, Manager Centrifugal Compressor Sales,  
The Cooper-Bessemer Corporation, explains...*

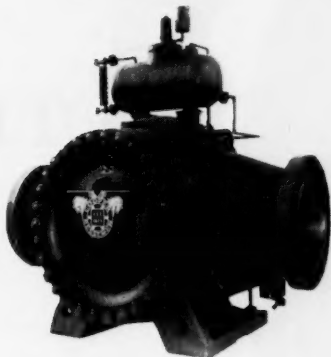
**How you gain four ways  
when you specify Cooper-Bessemer  
Centrifugal Compressors**



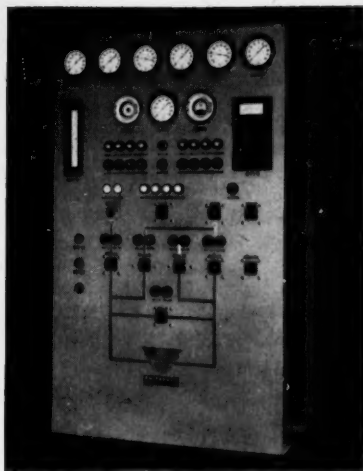
*Horizontally split, process air or gas centrifugal compressor. Range: Up to 100,000 cfm.*



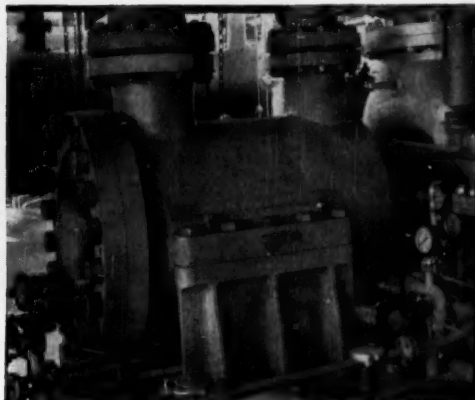
*Horizontally split, intercooled centrifugal compressor designed for low cost shop and process air and gas. Up to 30,000 cfm.*



*Pipeline centrifugal booster with a history of record-breaking performance. Up to 20,000 bhp.*



*Installations can be integrated with Cooper-Bessemer En-Tronic Controls all the way from simple monitoring to complete system automation.*



*Barrel type centrifugal compressor for gas and air at pressures up to 5000 psi.*

To get the most for your compressor dollars, it will pay you to check into Cooper-Bessemer Centrifugal Compressors because these fully-proved products offer you a combination of four outstanding advantages:

**1. You get a design that's matched to your needs.** A wide range of types and sizes of Cooper-Bessemer Centrifugal Compressors are available to assure optimum performance on your processing or air supply application.

**2. You get unsurpassed quality.** The designs include many field-proven distinctive features. Cooper-Bessemer's high standards of materials and craftsmanship are applied to every component of these precision-built units... to assure utmost reliability.

**3. You can get undivided responsibility.** We can engineer the entire compressor installation, including drive and controls. Cooper-Bessemer En-Tronic Controls are available to provide any degree of automation.

**4. You get service for most profitable performance.** Our outstanding field service and warehouse facilities assure

prompt attention to your operating needs...with resulting reduction in your inventory and downtime.

Our nearest office will gladly supply complete information on Cooper-Bessemer Centrifugal Compressors to meet your needs exactly. Call them today.

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He is the dynamic image of CF&I . . . the symbol of dependable steel products. Look for him when you buy.

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**40 Warehouses and 60 Sales offices located coast to coast**

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DENVER • OAKLAND • NEW YORK





**Fred Wheelwright, Industrial Sales Manager:** "The panels to the right deal with three distinct areas of processing

... separation of liquids; heat exchange and recovery, and separation of solids. In all three, De Laval equipment offers absolutely top-notch efficiency coupled with *high capacity* and *continuous operation*.

"De Laval centrifugal separators are designed for purification or clarification of liquids, or the concentration and recovery of solids from a liquid. De Laval Plate Heat Exchangers are used for product cooling or heating and for the recovery of process heat from sources otherwise going to waste.

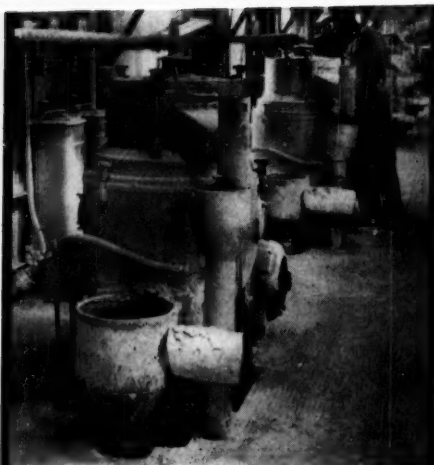
The "Syncro-Matic" Separators handle all sorts of solids ... wet or dry; fine or coarse, heavy or light ... in all sorts of classification and separation processes. In all of these areas the efficiency of De Laval equipment is unsurpassed; in many areas, it cannot be equaled.

"For more information on these, or any other De Laval products, just mail your request on your letterhead. No obligation, of course."



THE DE LAVAL SEPARATOR COMPANY  
Poughkeepsie, New York  
5724 N. Pulaski, Chicago 46, Illinois

DE LAVAL PACIFIC COMPANY  
201 E. Millbrae Avenue, Millbrae, California

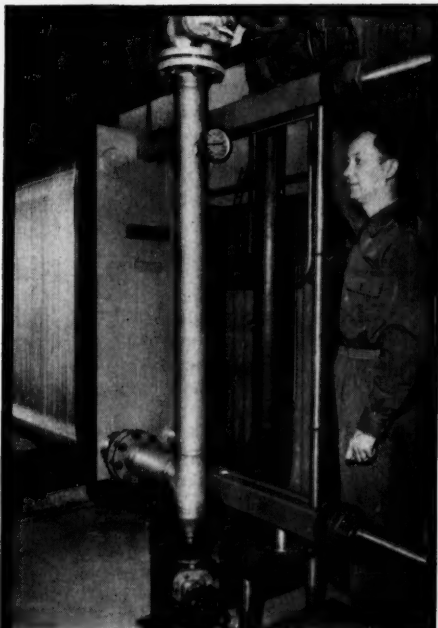


**CENTRIFUGAL SEPARATORS GIVE YOU CONTINUOUS, HIGH CAPACITY CONCENTRATION OF SOLIDS**

De Laval centrifuges bring you continuous, high capacity concentration of solids regardless of the amount, or particle size, of the solids present in a liquid. De Laval offers three types of continuous concentrators. The nozzle bowl (illustrated above as used in the production of Kaolin Clay) works like all our centrifuges, throwing solids to the outer sides of the bowl, except that the solids are discharged *continuously* through nozzles in the bowl wall. In the concentration of coarse or easily packed solids, one of our "Self-Opening" bowls is recommended. They operate similarly to the nozzle bowl, the difference being that solids accumulate to a predetermined level at which point an hydraulic device opens the bowl and the solids are discharged automatically. Both of these machine types can also purify or clarify the liquid phase as part of the same operation. A third type, the conveyor bowl centrifuge is ideally suited to removal of solids from a slurry or suspension, particularly where the mixture is too thick in consistency for practical application of other types. They have been found invaluable where the solids themselves are the desired end-product of the separation. To determine the exact machine for your own particular needs in these (or any other) processing areas, consult De Laval. Complete Pilot Plant and research facilities are at your disposal.

**GET MAXIMUM PROCESSING  
EFFICIENCY WITH DE LAVAL**





**ABSOLUTE TEMPERATURE  
CONTROL PLUS HEAT RECOVERY  
EFFICIENCY UP TO 95%**

The De Laval Plate Heat Exchanger enables you to maintain as little as 3° temperature differential between your product and the heating or cooling medium. Equipped with De Laval's exclusive Vacuum Steam Heating System, the unit responds *immediately* to changes in operating conditions and will hold to within 1° of preset temperature for as long as you wish. Manufacturers and processors have also found the Plate Heat Exchanger a source of profitable savings, using it to recapture process heat now being wasted and incorporating it into their heating system. However you use it, the unit is always custom-tailored to your exact needs. Its stainless steel plates have multiple benefits: corrosion resistance, easy cleaning, lack of maintenance problems, adaptability, elimination of thermal shock or product burn-on, plus highest heat transfer efficiency.

De Laval's Plate Heat Exchanger has found enthusiastic reception throughout the process industries. The illustration shows a unit installed in Chicago at the Petrochemical Department of the Continental Oil Company.

**NOW... A VIBRATING SCREEN  
SEPARATOR WITH  
MOTION CONTROLLED  
IN ALL THREE DIRECTIONS**

Horizontal, vertical, and gyratory motion are all individually controlled in De Laval's "Syncro-Matic" Separator with TDM (three dimensional motion) Control. It means a tremendous increase in throughput as well as an extraordinary increase in efficiency of separation. Calibrated controls indicate adjustment ranges for frequency and each element of motion. Once the optimum settings for a product have been determined, they can be noted and reset for immediate top efficiency whenever the same product is to be processed again. The action is not affected by a varying feed rate; efficiency is constant whether the machine is set for gentle or turbulent action. The machine is available in carbon or stainless steel with from one to three decks and a full range of screen meshes and materials. It requires no special mounting, and can be easily moved from one location to another. The base of the machine is practically vibrationless, and operation is exceptionally quiet. The "Syncro-Matic" has been successfully applied in chemical, food, mining, and other major industries. It may well be the perfect solution to your own screen separation problems.



## **PROCESS EQUIPMENT**

**CENTRIFUGES  
PLATE HEAT EXCHANGERS  
VIBRATING SCREENS  
COMPLETE PROCESSES**

# See why ALCOA ALUMINUM makes a good design habit

## Requirement: Increase original service life of process equipment Key to Good Design: Use Alcoa Aluminum to combat corrosion

Fighting corrosion is one of many ways aluminum can increase the original service life of your equipment. In major segments of the process industries, ALCOA® Aluminum is becoming the accepted standard for doing just this.

Chemical and petroleum plants find many uses for aluminum in their processes. Aluminum towers, driers and building products ward off atmospheric corrosion in sea-coast locations, salt mines, and in similarly aggressive environments . . . areas where other metals fail. The electric power industry uses aluminum to resist the corrosive effects of soot, flyash, gases and vapors from the combustion of coal. The food processing industry takes advantage of aluminum's other important features. Because it looks clean, is easily kept clean, and imparts no color or flavor to the product, aluminum is the best choice for pans, churns and vessels. These aluminum containers also have high heat conductivity . . . an important consideration where heat must be applied to the product.

The brewing and pharmaceutical industries use aluminum for still another reason. Here, process equipment must be nontoxic to micro-organisms. That's why aluminum pasteurizers and other equipment are specified for fermentation reactions in microbiological processes.

For other processes, aluminum's freedom from embrittle-

ment at extremely low temperatures makes it particularly attractive. Good examples are the production of hydrogen, helium, oxygen, and various other cryogenic substances.

There's an area in your process where ALCOA Aluminum can help cut costs or improve efficiency. ALCOA can help you specify the alloy you need from the wide range available. Each offers specific advantages, and there is one certain to fit your requirements.

ALCOA engineers have worked closely with all segments of the process industries for over 40 years, and their unparalleled experience in this field is available to you for the asking. Write to the address on the coupon, stating your requirements as specifically as possible. ALCOA's development engineers will welcome the opportunity to work with you on your problems.

You also can take advantage of the wide selection of free ALCOA literature on aluminum for process equipment. Simply check the booklets you want on the coupon and mail to the address indicated. ALCOA will forward your material promptly and without obligation.

ALCOA is conducting a series of engineering conferences on process industries applications of aluminum during 1959 in a number of major cities. Contact your nearest ALCOA sales office for full particulars and dates.

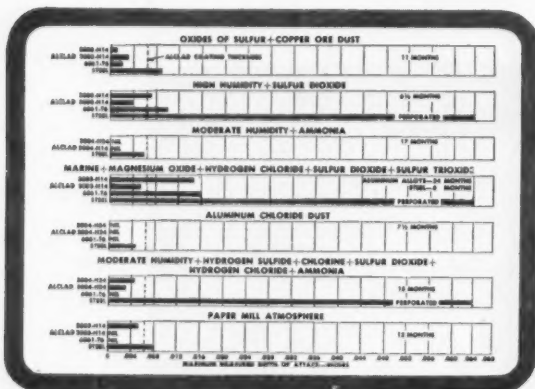
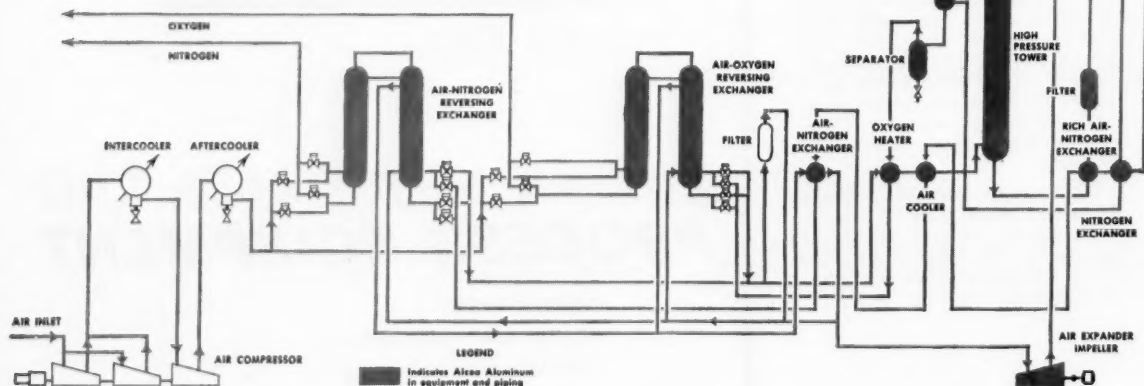
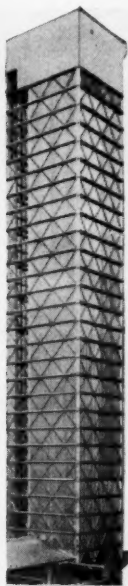


Diagram of first successful low pressure tonnage oxygen plant . . . designed to produce 175 tons of 95% oxygen per day for the manufacture of oxygenated chemicals. All the process piping and most of the equipment are Alcoa Aluminum.

Resistance of Alcoa Aluminum alloys to certain atmospheric contaminants, compared with steel.





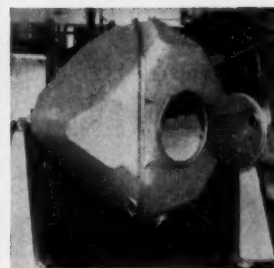
An aluminum prilling tower, 260 ft high by 40 ft square, used in the manufacture of solid ammonium nitrate. Auxiliary buildings are also covered with aluminum because of the corrosive atmospheres present.



Aluminum solidification pans and molds for solids such as stearic acid and waxes resist corrosion and do not discolor the product.



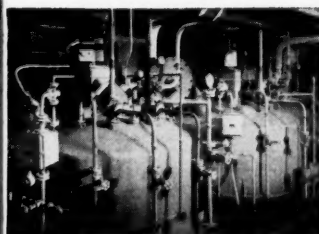
The naval stores industry uses aluminum to protect color and quality of rosin, rosin derivatives, turpentine and similar pine products.



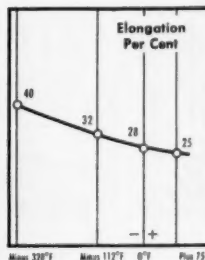
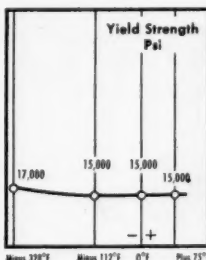
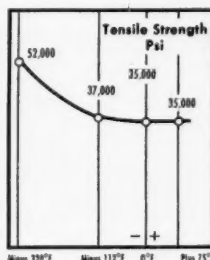
Butter has little tendency to adhere to the cast aluminum surface of this churn.



The sanitary appearance of aluminum covers and siding over these brewery pasteurizers is easily maintained.



These 3,000-gal aluminum adsorption tanks are used in the production of antibiotics. Aluminum distribution systems for acetone and deionized water also are shown.



Alcoa Alloy 5154-O is used extensively in process equipment, especially for cryogenic applications. The graphs above show how this alloy's physical properties actually improve at low temperatures. At minus 320 degrees F it improves 50% in tensile strength, over 13% in yield strength and approximately 60% in elongation.



Large scrubber tower for solvent recovery in a synthetic textile plant.



For exciting drama  
watch "ALCOA THEATRE,"  
alternate Mondays,  
NBC-TV, and  
"ALCOA PRESENTS"  
every Tuesday, ABC-TV

Aluminum Company of America  
871-C Alcoa Building, Pittsburgh 19, Pa.

Please send me the following literature on Alcoa Aluminum applications in the process industries:

- |  |   |
|--|---|
| <input type="checkbox"/> GL866—Unfired Pressure Vessels of Aluminum Alloys       | <input type="checkbox"/> 10387—Alcoa Standard Storage Tanks   |
| <input type="checkbox"/> GL149—Welded Aluminum Gas Cylinders, ICC approved       | <input type="checkbox"/> 20849—Resistance of Aluminum Alloys to Weathering and Resistance of Aluminum Alloys to Chemically Contaminated Atmospheres |
| <input type="checkbox"/> 10197—Aluminum Pipe and Fittings                        | <input type="checkbox"/> 20265—Have You Tried Aluminum in Your Refinery?  |
| <input type="checkbox"/> 10186—Alcoa Aluminum Heat Exchanger Tubes               | <input type="checkbox"/> GL93—Aluminum in the Pulp and Paper Industry   |
| <input type="checkbox"/> 10270—Alcoa Utilitube                                   | <input type="checkbox"/> 20272—Aluminum Alloys for Handling High Purity Water   |
| <input type="checkbox"/> 10460—Process Industries Applications of Alcoa Aluminum |   |
| <input type="checkbox"/> DD508—Aluminum Alloys in Tank Trucks and Tank Trailers  |   |

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IN A  
**"FOG"**  
 ABOUT  
 FILTERS?

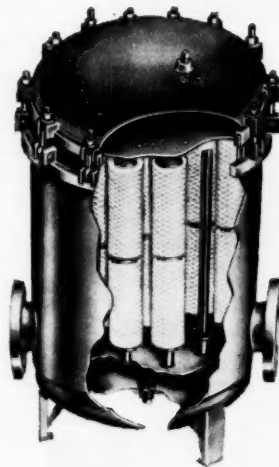
## Diamond Alkali Clears Up Paraffin Haze with *Fulflo Filters*

If you're in a fog about filters — or product impurities — take a tip from Diamond Alkali. This leading chemical producer achieves gleaming cleanliness of liquid chlorinated paraffins by a final polishing operation with low-cost Fulflo Filters. Highest quality product standards are maintained.

Diamond's liquid chlorinated paraffins have 30 to 150 poise (Brookfield) viscosity, and are clarified at a flow rate of 200-400 gph. Fulflo Filters are available in a wide range of models for high or low flow rate, viscosity, pressure, pH and temperature. They provide continuous micro-clarity, by true *depth* filtration, for all types of chemicals, oils, water, and other industrial fluids.

*Write for technical literature or engineering assistance  
 to Department CE.*

- These two Fulflo Filters, each with
- 110 Honeycomb Filter Tubes, re-
- move micronic particles which
- were causing haze in chlorinated
- paraffin produced by the Chlorin-
- ated Products Division of Diamond
- Alkali Company.



### COMMERCIAL FILTERS CORPORATION

MELROSE 76, MASSACHUSETTS

PLANTS IN MELROSE, MASSACHUSETTS AND LEBANON, INDIANA

**MICRO-CLARITY AT MINIMUM COST**



with genuine Honeycomb Filter  
 Tubes for controlled micro-  
 clarity of industrial fluids.

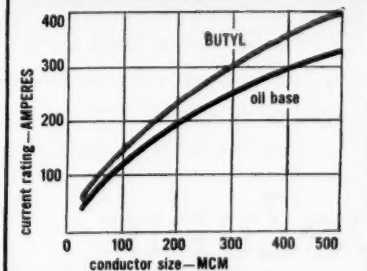
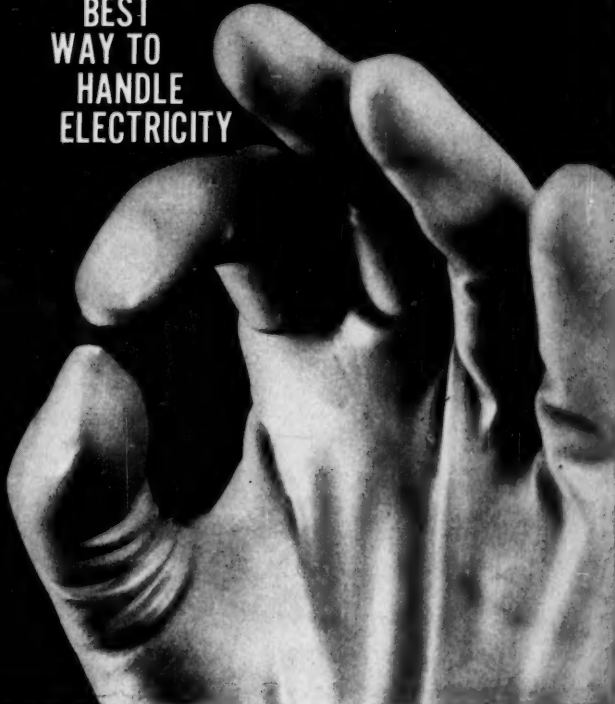


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WAY TO  
HANDLE  
ELECTRICITY



Butyl's outstanding resistance to heat allows considerably higher currents for any given conductor size.

Of all vulcanizable rubbers, Enjay Butyl offers the best electrical and dielectric properties. Butyl is the ideal material for wire and power cable, transformers, tapes, bus-bars and other insulation applications.

Butyl also offers outstanding resistance to weathering and sunlight . . . chemicals . . . abrasion, tear and flexing . . . superior damping properties . . . unmatched impermeability to gases and moisture.

Find out how this versatile rubber can improve your product. Call or write the Enjay Company, today!



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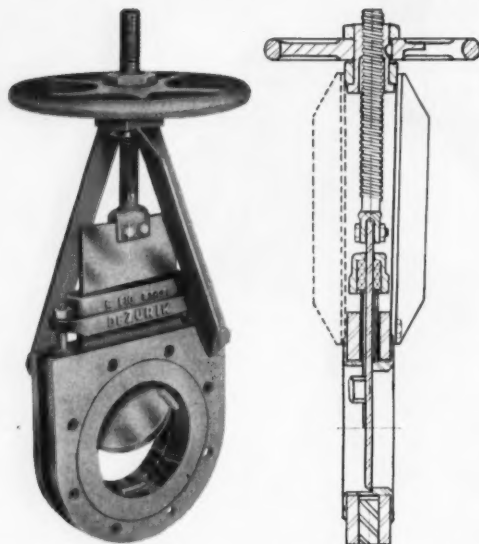
**FIBROUS...**

**VISCOUS...**

**CRYSTALLINE...**

**or DRY SOLIDS...**

## **VALVE THEM FOR LESS MONEY WITH DeZURIK BONNETLESS GATE VALVES!**



A growing number of processing plants are discovering the advantages that only DeZurik Bonnetless Knife Gate Valves can give them.

The bonnetless construction of DeZurik Gate Valves eliminates all cavities in the valve where material can pack. Their economical construction and light weight mean low first cost and low installation costs. Wafer face-to-face dimensions allow compact installation.

Some of the typical installations on which DeZurik Gate Valves have been installed include dry polyethylene pellets, crystalline sugar, thick syrup, sugar slurries, 50% salt crystals, titanium oxide,

ferric chloride dust, meat scraps and bones, uranium gas and uranium fines, dry fly ash and fly ash in slurry, detergent slurry, viscous pharmaceuticals, soap, chewing gum base, salt slurry, soot and many more.

Despite the corrosive or erosive aspects of many of these services, DeZurik Bonnetless Knife Gate Valves are the economical answer. Only the parts of the valve coming into contact with the flow need be of high alloys. The structural portions of the valve are fabricated of mild steel.

DeZurik Bonnetless Knife Gate Valves are available with a wide option of styles and metals. Ask the DeZurik representative in your area for more information, or write for Bulletin 300.

 **DeZURIK**  
**CORPORATION**  
SARTELL, MINNESOTA

# zero plus

**... and Carlson  
special stainless steels  
withstand the extremes  
of another launching**

WHEN this missile "lifts off," Carlson special stainless steel plates help launch it into space. These plates are the high strength, precipitation-hardening grades. And there are sound reasons why these grades are used.

First, with Armco 17-4PH, 17-7PH and PH15-7 Mo\* it is easier to attain the high physical properties and resistance to elevated temperatures required in space flight engineering. Simplified low temperature heat treatment will develop a Rockwell hardness of C40 to C50. Tensile strengths, so vital in missile components, range from 180,000 to 220,000 psi in plates.

Second, only Carlson produces these Armco grades in the heavier plate thicknesses. For applications where high strength at high temperatures and ease of fabrication are important, get plates in these grades from Carlson. We will be glad to work with you on specific applications.

\*17-4PH, 17-7PH and PH15-7 Mo are  
trade marks of Armco Steel Corporation

## G.O. CARLSON Inc.

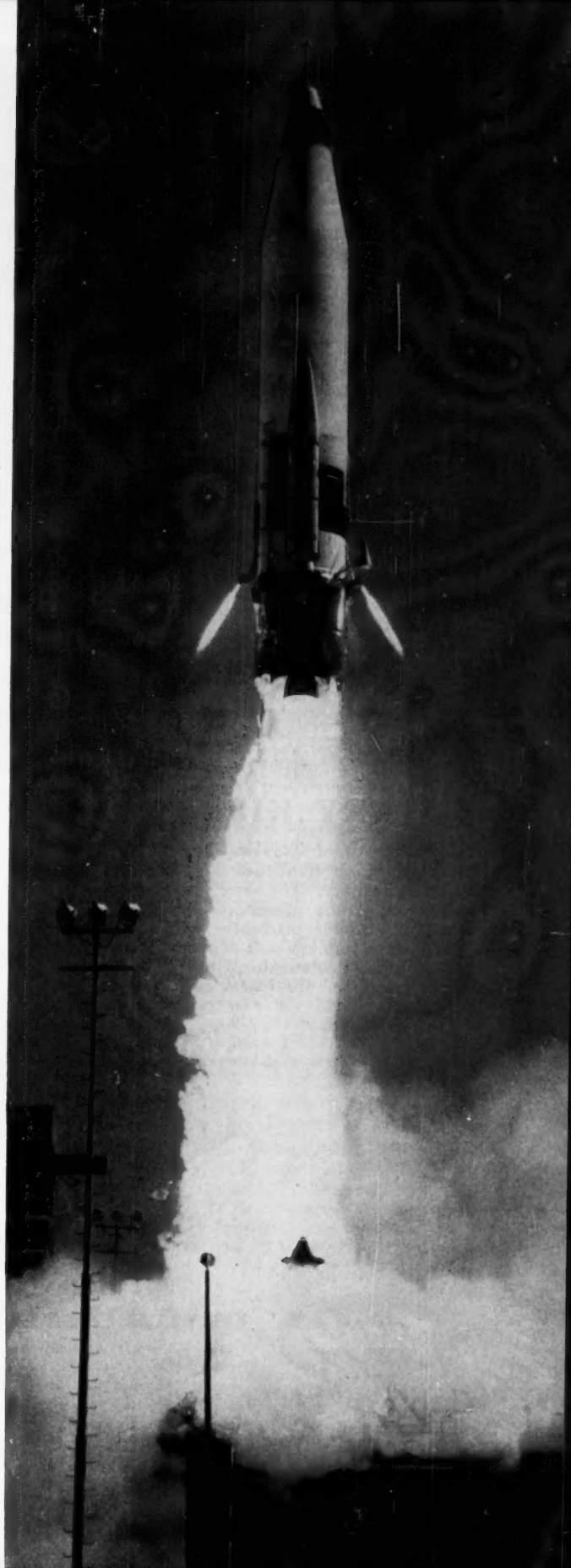
*Stainless Steels Exclusively*

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THORNDALE, PENNSYLVANIA  
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PLATES • PLATE PRODUCTS • HEADS • RINGS • CIRCLES  
FLANGES • FORGINGS • BARS and SHEETS (No. 1 Finish)

Photo of Atlas missile courtesy  
CONVAIR ASTRONAUTICS,  
A Division of General Dynamics Corp.



**precision  
engineered  
kilns**

**Traylor-made**



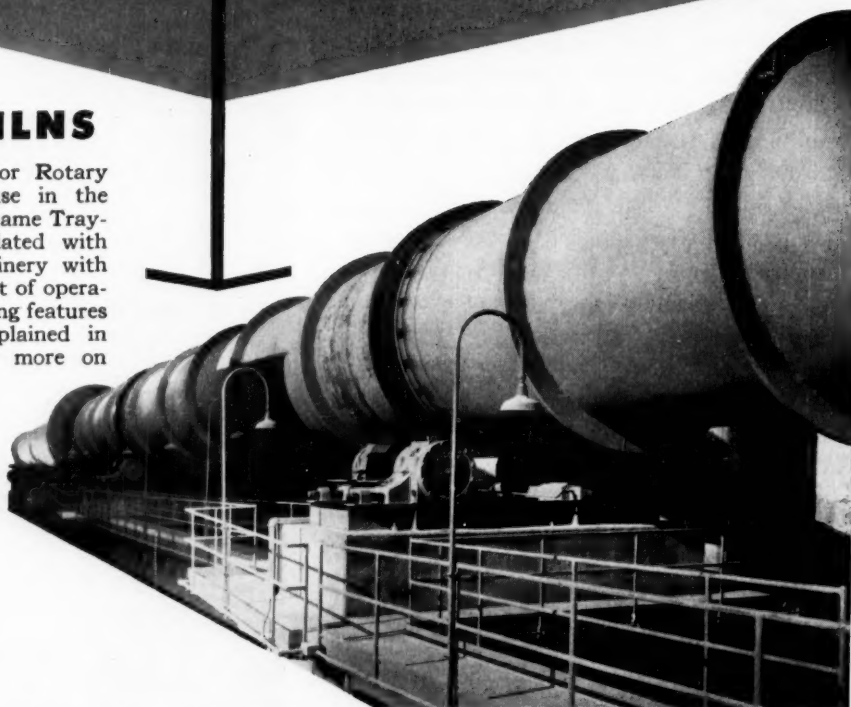
Auxiliary drive on a 7'-0" dia.  
x 250'-0" Rotary Kiln in a  
paper mill.



Plant view of a 9'-6" dia. x  
250'-0" Rotary Kiln in a  
portland cement plant.

## ROTARY KILNS

Many hundreds of Traylor Rotary Kilns are in constant use in the processing industry. The name Traylor has long been associated with rugged, dependable machinery with high efficiency and low cost of operation. The many outstanding features of Traylor Kilns are explained in Bulletin No. 1115. For more on Traylor, write today!



**TRAYLOR ENGINEERING & MANUFACTURING COMPANY**

1130 MILL ST., ALLENTOWN, PA.

Sales Offices: New York — Chicago — San Francisco

Canadian Mfr.: Canadian Vickers, Ltd., Montreal, P. Q.

# How Much Steam Should a Steam Trap Trap?

... some answers to commonly asked questions about the primary job of a steam trap

You don't need a doctor's degree in thermodynamics to answer the question at the top of this page. Naturally, a steam trap should trap *all* the steam.

Unfortunately for you, the problem isn't quite that simple. After all, a shut off valve would trap all the steam ... and condensate, and air, and carbon dioxide as well.

So we'd better amend the answer to the question this way: A steam trap should trap *all* the steam but *must* remove condensate, air and carbon dioxide as rapidly as they accumulate.

With this established, let's take a closer look at what's involved:

## A Steam Trap Should Trap All The Steam

If you've had experience with several different makes of traps, you already know that some trap steam better than others. The operating principle of the trap is what makes the difference. We like to talk about it because Armstrong traps are designed so that no steam can get to the orifice. The valve is always water sealed. Result: *More efficient steam utilization, lower fuel costs.*

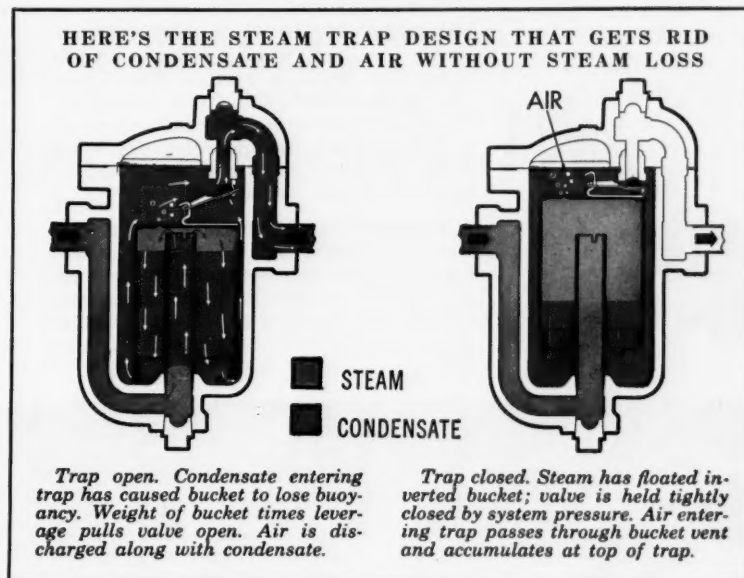
## A Steam Trap Should Remove Condensate

All traps remove condensate—after a fashion. For maximum efficiency in the unit being drained, though, the trick is to get it out without waiting for it to cool and without leaking steam.

Armstrong's water sealed valve takes care of steam leakage. The inverted bucket operating principle opens the trap for water regardless of its temperature. This means you get the condensate out as quickly as it accumulates. Result: *Higher temperatures and better heat transfer in steam heated units.*

## A Steam Trap Should Remove Air and CO<sub>2</sub>

Part and parcel of the condensate removal problem is removal of air as well as oxygen and carbon dioxide—two real troublemakers. Air tends to reduce operating temperatures and interfere with heat transfer. CO<sub>2</sub> goes into solution to form



corrosive carbonic acid which, for example, can eat unit heater tubes. O<sub>2</sub> aggravates the situation. Believe it or not, but all traps don't properly remove air and CO<sub>2</sub>.

By now, you've probably guessed that Armstrong traps *do* remove air and CO<sub>2</sub>. Armstrong design (see illustration) provides continuous venting of air and CO<sub>2</sub>. By opening suddenly, the Armstrong trap creates a momentary pressure drop to "pump" the air down to be vented. Result: *Higher temperatures, faster heat-up, better heat transfer and reduced corrosion.*

*Note: When required, specially sized air vents are furnished. For fast heat-up of low pressure on-and-off units, Armstrong provides open float and thermostatic air vent traps.*

## What's the Final Answer?

Summing it all up, you'll get the best service from steam heated units that are equipped with traps designed to trap *all* the steam and remove air and condensate as quickly as it accumulates. In our prejudiced viewpoint, this means Armstrong traps. More important are the several thousand users of Armstrong traps who have proved the point.

Before you make up your mind, though, consider the minimum maintenance requirements of Armstrong traps ... and the convenient assistance your local Armstrong Representative provides. These are important plus values.

## Put Up or Shut Up

We're so confident that we "put up". Armstrong traps are unconditionally guaranteed to satisfy. So you can find out for yourself with practically no risk. If you're not completely satisfied with the way they do their job, you can get your money back.

\* \* \*

The 44-page Armstrong Steam Trap book goes into greater detail on these and other Armstrong features. It also discusses trap selection, installation and maintenance. Ask your Armstrong Representative for a copy or write

Armstrong Machine Works  
8583 Maple Street  
Three Rivers, Michigan



**ARMSTRONG**  
**STEAM TRAPS**



# 10 hours' work in an 8-hour shift!

## That's the production advantage of the Yale Industrial Tractor Shovel

Here are the features that make the Yale Industrial Tractor Shovel outstanding...

### PRECISELY CONTROLLED HORSEPOWER!

72 hp. 6 cylinder engine provides smooth power through matched torque converter and Yale torque transmission (fully automatic). One speed in both directions. Inching control permits delicate close-quarter maneuvering. Extra punch for impact loading. Accelerates to 13 mph. in 5½ seconds.

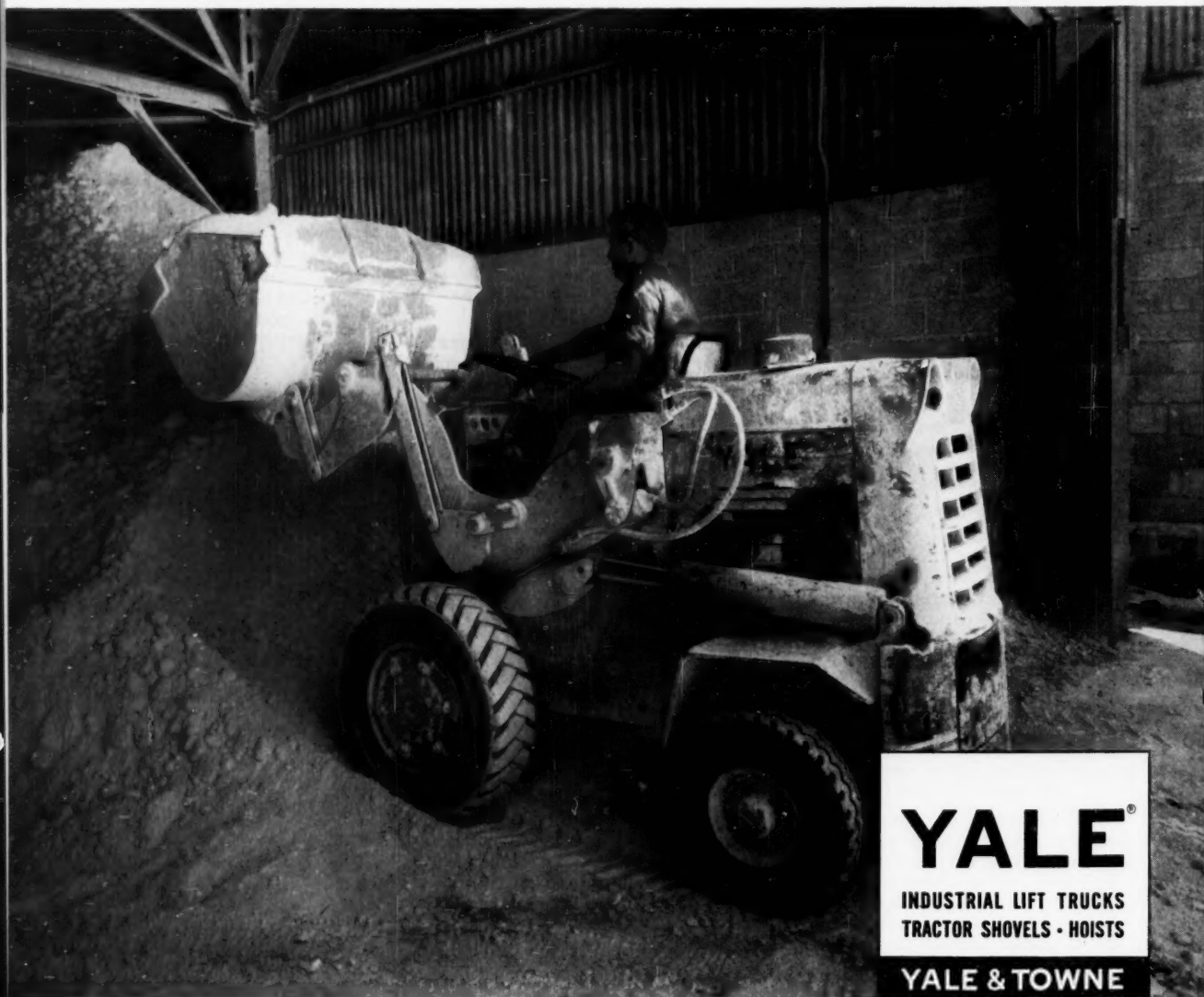
**PERFORMANCE!** 2500 lb. carry capacity. Exclusive 45° bucket tipback permits faster loading and lowest carry position for faster transport with minimum spillage. 6' dumping clearance permits dumping into bins and hoppers out of range of other—even larger—tractor

shovels. Shortest turning radius, too—only 73".

**SAFETY!** Safety-curve lifting mechanism members never rise alongside the operator. Front and back working lights provide extra security.

**DEPENDABILITY!** Rugged design • sealed brakes and electrical system • protected steering linkage • 10 ply tires—all adds up to more work at less cost...more production hours. Full range of buckets and attachments available.

Field applications prove that these features add up to 25% more work per hour—10 hours' work in an 8-hour shift. For a demonstration in your plant or complete information contact your Yale representative. Or write The Yale & Towne Manufacturing Company, Yale Materials Handling Division, Dept. YT 2-V.



# YALE®

INDUSTRIAL LIFT TRUCKS  
TRACTOR SHOVELS • HOISTS

YALE & TOWNE

Yale Materials Handling Division, a division of The Yale & Towne Manufacturing Company. **Manufacturing Plants:** Philadelphia, Pa., San Leandro, Calif., Forrest City, Ark. **Products:** Gasoline, Electric, Diesel and LP-Gas Industrial Lift Trucks • Worksavers • Warehouse • Hand Trucks • Industrial Tractor Shovels • Hand, Air and Electric Hoists



## *What the old timer said to the young engineer about buying cooling towers*



"Buy 'em big, young man. That's the only way you can be sure the tower will handle your job."

"Isn't that expensive?" asked the young engineer. "Why can't we specify the exact capacity we need and get bids on the proper size tower? Seems like we would save money."

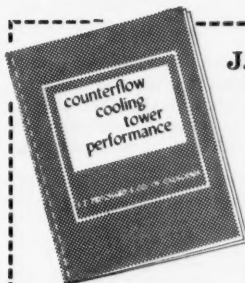
"Not enough known about tower performance, so play it safe and buy it big."

The Old Timer has a point. And, until now, he was forced to abide by it — forced to buy in the dark and pay the penalty of over-buying to protect his company. But there's been an important change. Now, for the first time, all of the information needed to determine counterflow cooling tower performance is available in one easy-to-use handbook.



Ask Pritchard to bid on the next cooling tower you need — then check our figures using the Performance Handbook. You'll see in black and white how a Pritchard Cooling Tower gives you more value for your money.

This handbook, entitled "Counterflow Cooling Tower Performance" also can be used to check tower selections before you buy. It contains technical data and charts prepared by leading authorities in cooling tower design. It's available from Pritchard for \$3.00. Mail coupon below and check or money order for your copy.



### **J. F. PRITCHARD & CO. OF CALIFORNIA**

Dept. 110, 4625 Roanoke Parkway, Kansas City 12, Mo.

- ☐ Enclosed is \$3.00. Please send copy of "Counterflow Cooling Tower Performance"
- ☐ Please send free copy of new Counterflow Cooling Tower Bulletin 4.9.080A
- ☐ Please have your representative call on me

Name \_\_\_\_\_ Title \_\_\_\_\_

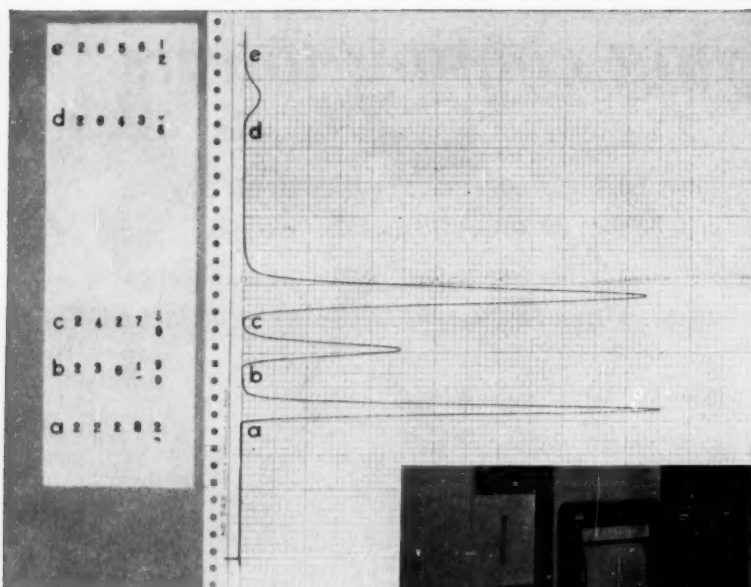
Firm \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

# Now...automatic printed integration of chart peak areas

*Perkin-Elmer's new Model 194 presents 6000-count/minute integrals on adding machine tape, ready for interpretation*



Fractogram of four-component mixture with integrator tape run in synchronous mode. The synchronous tape feed permits easy identification of integral prints with the corresponding peaks on the fractogram. Corresponding prints and printing points on the fractogram are identified by letters (a, b, c, d and e).

Integrals for each peak are obtained by subtracting the value printed at its leading edge from that printed at the leading edge of the next peak. Thus,

Propane = (b - a) = 23619 - 22282 = 1337  
Isobutane = (c - b) = 24278 - 23619 = 659  
n-Butane = (d - c) = 26436 - 24278 = 2158  
Isopentane = (e - d) = 26561 - 26436 = 125

Concentrations for each component are computed by dividing the integral for its peak by the total integral (after applying thermal conductivity correction factors if necessary). The complete analysis of this mixture is:

Propane . . . 31.3%; Isobutane . . . 15.4%;  
n-Butane . . . 50.4%; Isopentane . . . 2.9%.

Up to now, there have been four conventional methods of integrating the areas of peaks produced on a recorder chart by a gas chromatographic analyzer — for example:

**FIRST:** the time-consuming, error-prone approximation of measuring peak height and multiplying by half band width; only as accurate as the analyst's eye and scale at best, not valid for some peak shapes, and requiring a good deal of computation.

**SECOND:** so-called "pip" integration — using an auxiliary pen which dithers along the chart edge as the peak



is recorded and the integrator counts (with each group of ten counts marked by a wider pen swing to facilitate counting). The disadvantages of this technique: low count rate/lower accuracy, with the inherent mechanical difficulties of "pip" recording by pen. You also have to count the pips!

**THIRD:** digital counter read-out — excellent integration, but demanding constant vigilance on the part of the operator to note dial readings at critical moments during peak elution.

**FOURTH:** planimeter area measurement, requiring a steady hand and

virtually infinite patience — and not very accurate, either.

With Perkin-Elmer's new Model 194 Printing Integrator, designed for use with the P-E Model 154-C Vapor Fractometer, integrals are *printed* on standard adding machine tape, automatically at the base of each peak (or manually, on command) and in a variety of modes.

When the recorder pen begins an upscale excursion, a valley sensor in the recorder energizes the printing mechanism, and a five-digit integral is automatically printed on the tape. Tape and recorder chart move at the same speed, making later comparison and identification easy — or the tape can space evenly between prints. The next integral is automatically struck when the pen begins to record the next peak; the difference between this number and the first represents the area of the first peak. The last integral in an analysis is manually printed.

When the Model 154-C recorder is *attenuating automatically* to keep peaks on scale, the Printing Integrator will follow the recorder through attenuation changes and present compensated integrals at analysis' end.

The peak areas, added and normalized, give gross concentration percentages. Introducing thermal conductivity coefficients, where necessary, will give quantitative measurements six to ten times as precise as pip-marking methods or conventional physical measurement of the chart peaks.

The Model 194 (\$1,375 f.o.b. Norwalk, Conn.) employs a standard velocity servo computer. At full scale, the Integrator produces 6000 counts per minute, or 1263 per square inch of chart space. The recorder pen/count linearity is within  $\pm 0.3\%$ , averaged over full scale.

For more information, write for "Automatic Printed Integration of Recorder Data," to 785 Main Avenue, Norwalk, Conn.

Price subject to change without notice.

INSTRUMENT DIVISION

**Perkin-Elmer** Corporation  
NORWALK, CONNECTICUT

March 9, 1959—CHEMICAL ENGINEERING



## GUIDANCE...

It was only when man recognized nature's navigational "signposts" in the skies, and learned to read them, that he gained mastery over the seas.

In the same way, the processing industries have welcomed guidance, and utilized every opportunity designed to help them toward more efficient and economical operation. Our contribution — in the field of grinding, air conveying and dust collection — is embodied in the Mikro Plan. The Plan includes: Mikro Engineering, which works con-

stantly to create equipment for new uses and to improve existing methods . . . Mikro Laboratory Analysis, aimed at more effective methods of processing customers' materials . . . and Mikro Service, organized on a world-wide basis for on-the-spot solution of problems, and the shipment of genuine MIKRO replacement parts to any point within 48 hours of order.

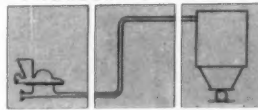
Our experience and facilities are at your disposal without obligation. Call on us at any time.

## MIKRO-Products

Pulverizing Machinery Division • Metals Disintegrating Company, Inc.  
85 Chatham Road • Summit, New Jersey



### PROCESSING SYSTEMS

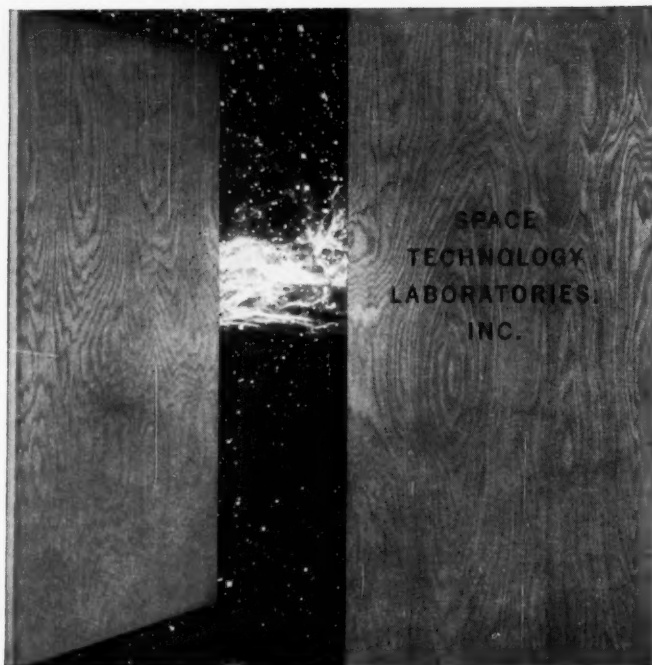


GRINDING CONVEYING COLLECTING

REPRESENTATIVES throughout the United States, Continental Europe, British Isles, Canada, Mexico, Central and South America, West Indies, South Africa, India, Japan, Philippines, Australia and New Zealand.

MANUFACTURING FACILITIES: United States, Canada, Continental Europe, British Isles.

# Research: opens the door to space



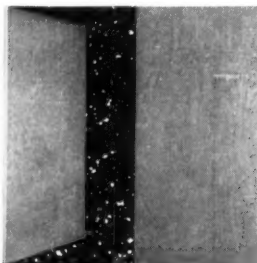
Space Technology Laboratories is responsible for the over-all systems engineering, technical direction, and related research for the U.S. Air Force Ballistic Missile Programs. To carry out the fundamental investigations of those physical phenomena related to very advanced and long-range problems of space technology, STL established the Physical Research Laboratory.

This laboratory is making significant contributions in experimental and theoretical research in the fields of controlled fusion and associated plasma physics, magnetoaerodynamics and low temperature solid state physics.

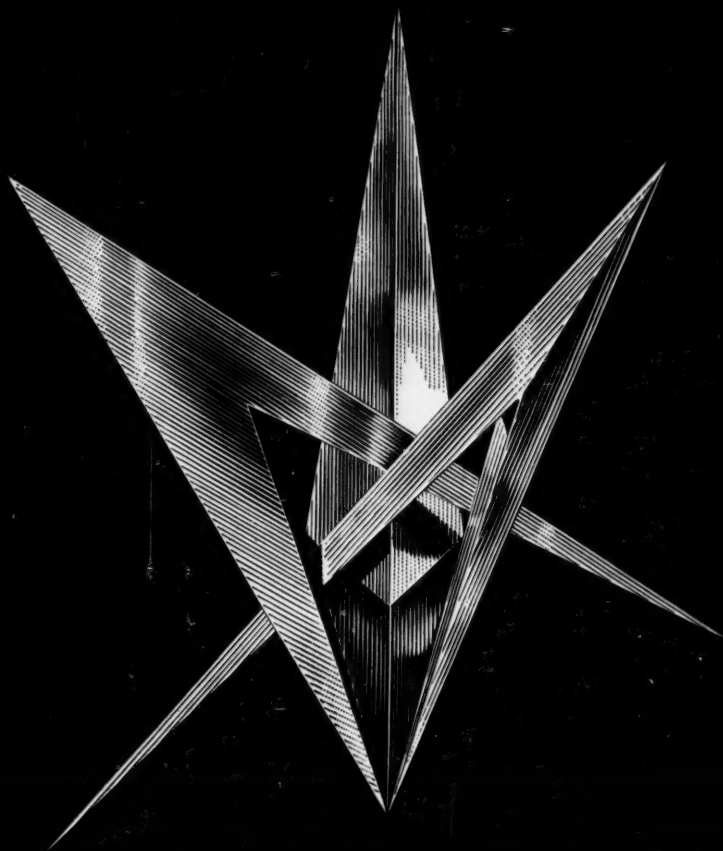
Dr. Milton U. Clauser, Vice President of the Company and Director of STL's Physical Research Laboratory, draws upon a rich background of industrial, as well as academic, experience and achievement in charting the areas of research that will be important to the space technology of the future.

The professional staff of the Physical Research Laboratory, the majority of whom hold the Doctorate, are supported by unusual shop facilities and a complete staff of technicians. Also available is an outstanding digital computing center within the STL complex. Scientists and engineers with competence and imagination in fields related to advanced cryogenics, fusion physics and magnetohydrodynamic investigation, are invited to inquire about Staff positions.

Space  
Technology  
Laboratories,  
Inc.



P.O. BOX 95001, LOS ANGELES 45, CALIFORNIA



# SERVICE

## IN STAINLESS STEEL

"FLIGHT OF PROGRESS"

a stainless steel sculpture by Robert Edward Hamilton

In the past 12 months 91% of all orders for J&L stainless steel bars were shipped, *at least in part*, within 24 hours.

*That's service!*

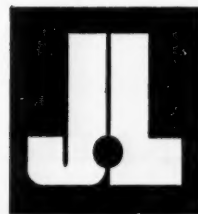
The key to such service is a simple one: Complete and balanced inventories at the Mill *and* at strategically located Service Centers only hours from *your* plant or warehouse.

With the most modern flat rolling facilities in the industry now in operation at Louisville, Ohio, J&L is now giving the same service on flat rolled products that fabricators and warehouses have been getting on J&L bars and wire.

Whether you need stainless sheet, strip, bar or wire for your production line or your warehouse customers, *you can get it faster from J&L.*

*Plants and Service Centers:*

Los Angeles • Kenilworth (N. J.) • Youngstown • Louisville (Ohio) • Indianapolis • Detroit

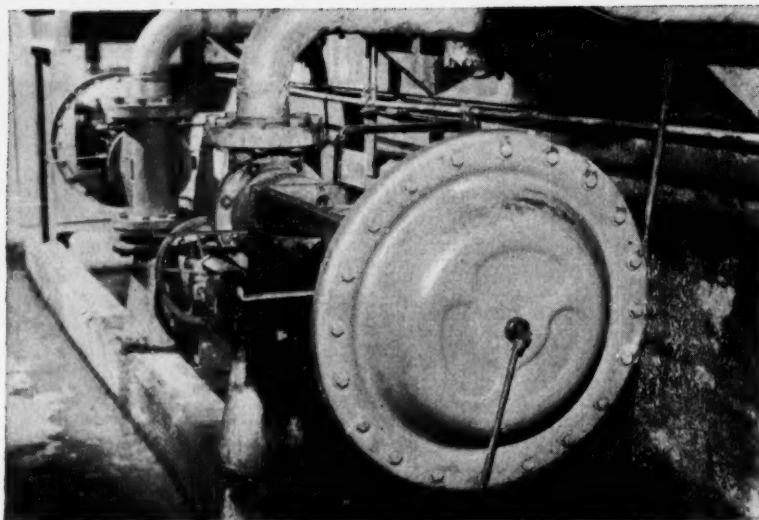


**STAINLESS**  
SHEET • STRIP • BAR • WIRE

**Jones & Laughlin Steel Corporation • STAINLESS and STRIP DIVISION • Box 4606, Detroit 34**



# Found: a valve responsive to sensitive instrument control, with low maintenance



Grinnell-Saunders Straightway Diaphragm Valves on back of Trimbe meter on Mead Corporation's No. 10 paper machine.

Grinnell-Saunders Straightway\* Diaphragm Valves were originally selected by Mead Corporation for stock level control at its Chillicothe, Ohio paper making plant. Mead's instrumentation specialists wanted a valve which would provide fine control in response to sensitive instruments.

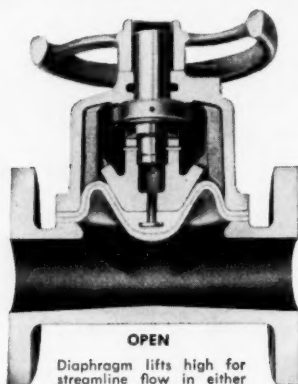
Because these Straightway Valves also avoid difficulties from clogging, stringing and dewatering as well as leakage, plugging, sticking and erosion, they have since been specified for other services throughout the plant.

Grinnell-Saunders Straightway Diaphragm Valves solve tough problems in many piping systems. They provide special benefits in lines handling corrosive fluids, viscous material, fibrous slurries, sludges, solids in suspension and semi-fluid materials.

These highly efficient valves provide streamlined flow, positive closure, complete isolation of operating mechanism, minimum maintenance, interchangeability of parts, manual or power operation, and a choice of body lining and diaphragm materials.

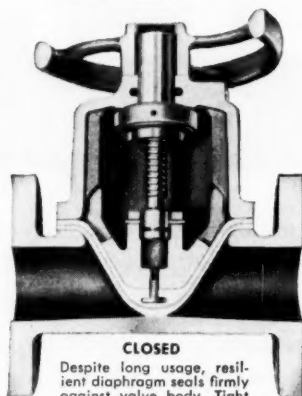
For complete information on straightway or standard weir types, handwheel, lever, or power operated, write Grinnell Company, Inc., 277 West Exchange Street, Providence 1, Rhode Island.

\*PATENTED



OPEN

Diaphragm lifts high for streamline flow in either direction. Also, valve design permits comparatively simple rodding through, when necessary.



CLOSED

Despite long usage, resilient diaphragm seals firmly against valve body. Tight closure is assured, even when handling gritty or fibrous materials.

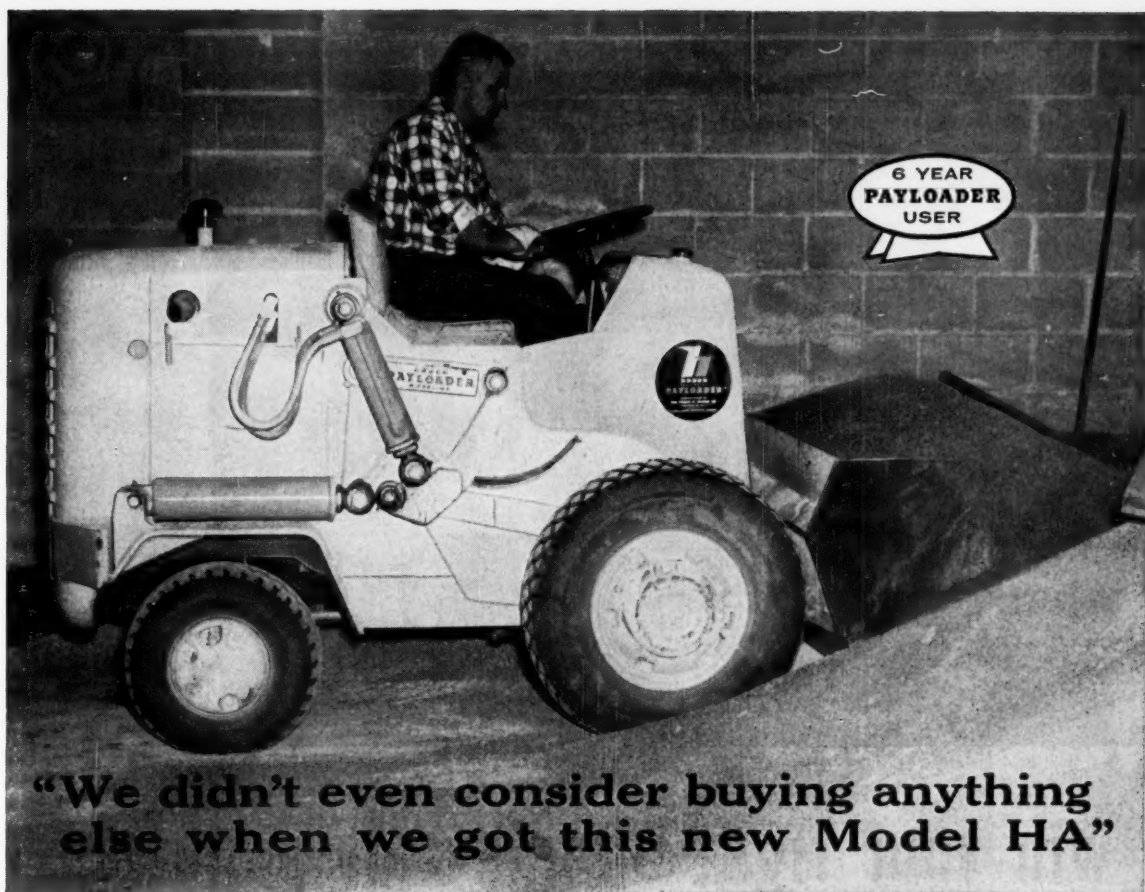
## GRINNELL-SAUNDERS DIAPHRAGM VALVES



Grinnell Company, Inc., Providence, Rhode Island

Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves  
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies  
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems



**"We didn't even consider buying anything else when we got this new Model HA"**

Continental Fertilizer Co. supplies farmers in the vicinity of Nevada, Iowa with custom-mixed and ready-to-use fertilizers of various types. For more than six years this firm used a Model HA "PAYLOADER" tractor-shovel to unload box cars of raw materials and move these ingredients from various bins for dry blending and liquid fertilizer preparations.

They traded the old one for a new Model HA "PAYLOADER" (2,000-lb. carry capacity) last August. "Because of the exceptional, reliable performance we had had we didn't even consider buying anything else," says Oliver Haley, President and Manager. "Fertilizer dusts are tough on equipment, just like emery cloth. Yet our old HA was used 16 to 20 hours non-stop during the busy season and, in 6 years, we never had the head off the engine . . . never gave it anything but normal care for brakes, points and plugs."

# HOUGH®



THE FRANK G. HOUGH CO.  
LIBERTYVILLE, ILLINOIS

SUBSIDIARY — INTERNATIONAL HARVESTER COMPANY



The same kind of performance and reliability is reported by chemical and fertilizer plants of every size on all sizes of "PAYLOADER" tractor-shovels from the model HA up to the big 4-wheel-drive 9,000-lb. carry capacity unit. There is a "PAYLOADER" model that can fit into your equipment plans too—that will help increase production and reduce bulk-material handling costs. Your nearby Hough Distributor is ready to give you the benefit of his extensive tractor-shovel knowledge and experience. Ask him about Hough Purchase and Lease Plans too.

**THE FRANK G. HOUGH CO.**

754 Sunnyside Ave., Libertyville, Ill.

Send PAYLOADER tractor-shovel data

Name \_\_\_\_\_

Title \_\_\_\_\_

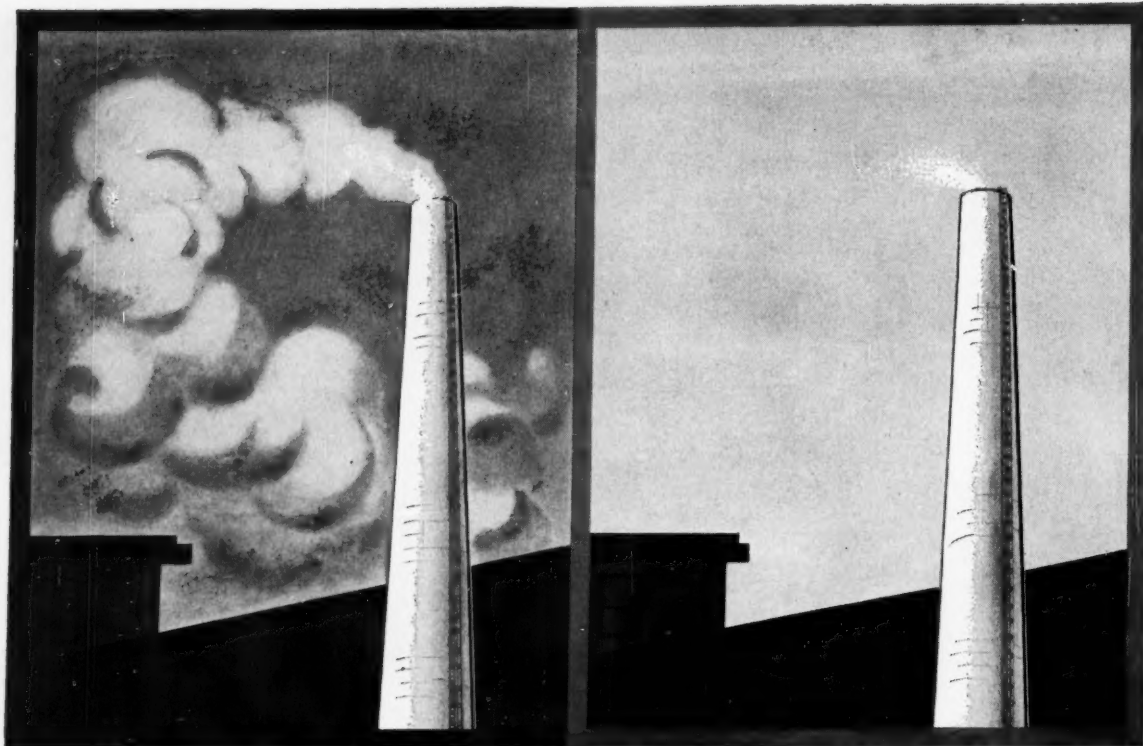
Company \_\_\_\_\_

Street \_\_\_\_\_

City \_\_\_\_\_

State \_\_\_\_\_

3-A-1



## win your fight against air pollution with a **Dracco Dust Control System**

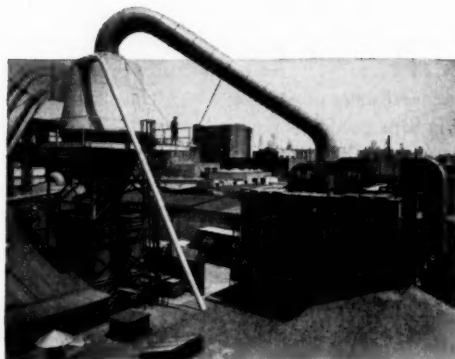
Dracco can be your most helpful ally in the fight against air pollution.

For over 40 years, Dracco has specialized in producing cloth filtration and cyclonic equipment for control of airborne particles. This includes a comprehensive variety of collectors and filters to solve any industrial dust or fume problem, large or small.

Today Dracco systems satisfy the toughest anti-pollution laws in many of the nation's largest metropolitan areas. In anticipation of even more stringent ordinances, Dracco research is developing advanced filtering media and radically new agglomeration and collection techniques.

You can take advantage of this know-how by consulting Dracco on your problems of producing your company's most important new product—*pure air!* The result will be a soundly engineered system that combines economy with reliable long-term service.

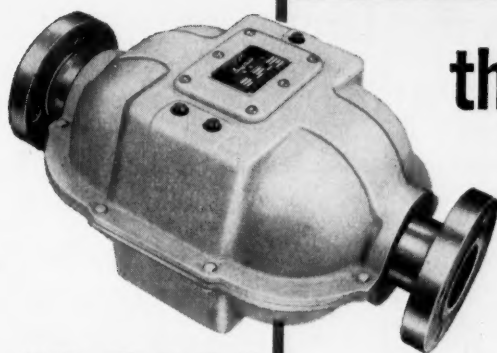
When you are ready to tackle that air pollution job, remember Dracco.



Multi-Bag Filter collects over ½ ton of dust daily at large eastern manufacturer, meets strict metropolitan air pollution requirements.

**DRACCO** DIVISION OF  
FULLER CO.  
4040 East 116th Street • Cleveland 5, Ohio

**DRACCO** *airstream conveyors*  
dust control equipment  
(Pronounced Dray-co)



the meter with  
**NO** flow  
restrictions

now  
handling  
all  
these  
difficult  
liquids

Foxboro's first Magnetic Flow Meter went "on stream" in 1954. Today, this new-type meter has gained industry-wide application for precise, linear measurement of corrosive, viscous and other difficult process liquids.

The Magnetic Flow Meter is installed as simply as a length of pipe, with no straight runs required. It connects by standard electric cable to remote Foxboro Dynalog\* Electronic Recorder. Overall accuracy of the system is  $\pm 1\%$ . And the meter even measures reversing flows.

With easy-to-measure liquids, or with tough ones like those listed below, the performance-proved Foxboro Magnetic Flow Meter provides flow measurement with no line restrictions. For complete details, write today for Bulletin 20-14C. **The Foxboro Company, 363 Neponset Ave., Foxboro, Mass.**

\*Reg. U.S. Pat. Off.

#### CHEMICALS

hydrochloric acid  
ammonium nitrate solution  
phosphate slurry  
rayon viscose  
magnesium carbonate slurry  
phosphoric acid  
rosin size  
starch solution

rubber copolymer  
liquid latex  
detergent concentrate  
sulphuric acid  
70% sodium hydroxide  
soap flow  
styrol  
magnesium hydrate

#### FOOD

beer  
grape juice  
apple juice  
pineapple juice  
tomato juice  
milk  
starch slurry  
sugar syrup  
coffee slurry  
molasses

aluminate liquor  
uranium ore slurry  
thickener mud  
cement slurry  
flue dust slurry  
acid wastes

#### PULP & PAPER

all types of pulp stock  
cooking liquors  
spent liquors  
bleaching chemicals  
lime mud slurries  
sizes  
alum  
dyes

#### OIL INDUSTRIES

drilling mud  
phosphoric acid  
ethanol extract  
scrubber recycle water  
urea solution  
nitrate solution  
spent acid  
sodium silicate & water  
sodium chloride brine  
tar-sand slurry

#### METALS AND MINING

pickling acid  
sand slurry  
ferrous chloride  
limestone shale slurry  
bauxite slurry  
gilsonite slurry

#### WATER & SEWAGE

activated sludge  
fresh water  
raw sewage  
digested sludge  
primary sludge  
return activated sludge

METER SIZES RANGE FROM  $\frac{3}{8}$  INCH TO OVER 6 FEET PIPE DIAMETER

**FOXBORO**  
REG. U.S. PAT. OFF.

**MAGNETIC  
FLOW  
METERS**

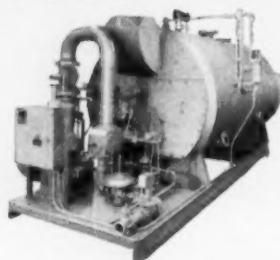


# Eclipse vaporizers for Dowtherm cut high-temperature process heating costs

... nine units provide flexible, accurate, high-temperature control and safe, low pressures at Eastern plant

How to get an exact amount of heat to a particular place at low cost in order to maintain product uniformity is a big problem faced by high-temperature process heat users.

Direct fire under the cooking or heating vessel is hard to control and seldom safe. Steam requires high pressures for high temperatures. This presents safety and control problems, and requires costly extra-heavy equipment.

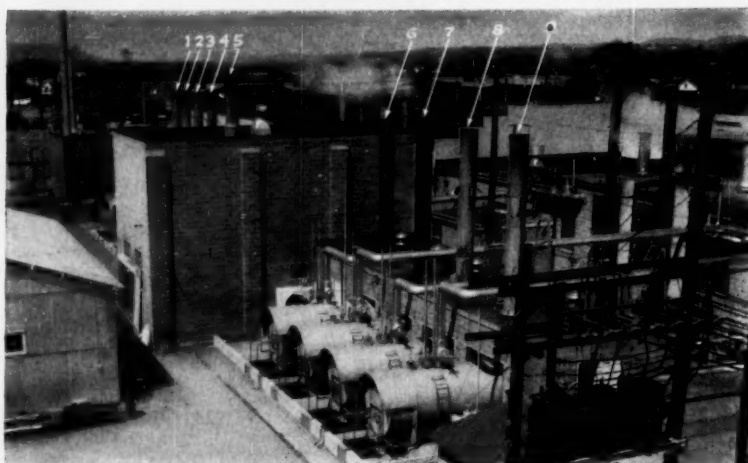


**ECLIPSE VAPORIZERS FOR DOWTHERM.** Available in vertical or horizontal models for gas, oil, or combination firing in 33 sizes from 30,000 to 6,000,000 Btu/hr—temperatures to 700° F.

## The Answer

A large Eastern plant has answered the problem with nine Eclipse vaporizers for Dowtherm. The units are similar to packaged steam boilers. But Dowtherm is the heating medium instead of steam.

Dowtherm is extremely stable in the 350° F to 700° F temperature range, permitting highly accurate heat control. Even at 700° F, Dowtherm exerts only 95 lb per square inch. This means heavy equipment,



**NINE ECLIPSE VAPORIZERS** for Dowtherm maintain cooking oil temperatures at a constant 375° F at a large Eastern food products plant. The accurate temperature control made possible by using Dowtherm takes the headaches out of maintaining product uniformity. The multiple-unit setup provides great flexibility for varying load or temperature demands. Also downtime on a single unit does not seriously affect production. Vaporizers are installed outdoors, eliminating the cost of a special building.

and piping, valves, etc., are not required—bringing welcome savings on original equipment, operation, maintenance, and replacement.

Because of the high rate of heat transfer, it is possible to have relatively low temperature differential between the heat transfer medium (Dowtherm) and the product. This means more efficient operation, less maintenance, and fuel savings.

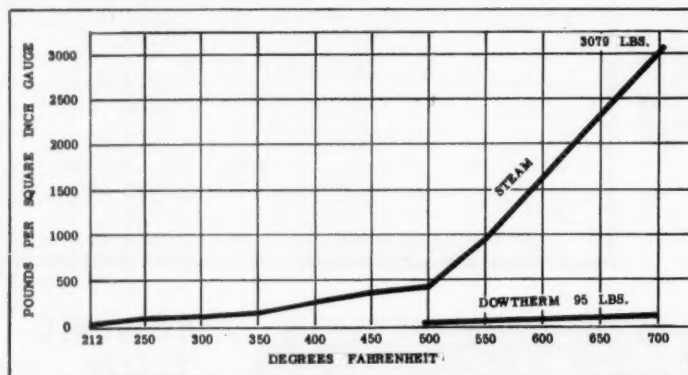
## Eclipse exclusive design features

The large, enclosed furnace of Eclipse horizontal vaporizers for Dowtherm permits high heat out-

put without strain. Burning gases flow turbulently through immersed fire tubes to the stack. Turbulent flow, plus small, specially designed fire tubes, increases heat transfer rate and minimizes flue loss. Vigorous natural circulation around the tubes guards against Dowtherm breakdown, eliminates carbon deposits on vital heat exchange surfaces, and reduces maintenance costs.

All units, vertical or horizontal, are compact, self-contained, automatic heating plants. These units arrive on the job assembled and tested, ready to go to work.

Eclipse has pioneered vaporizers for Dowtherm since the early days of this unique heating medium. The experience thus gained assures you a highly efficient and economical system. For complete details, write, outlining your requirements.



**DOWTHERM VS STEAM**—at 700° F, Dowtherm system pressure is only 95 psig. At this temperature saturated steam would exceed 3000 psig.

ASK FOR CATALOG A-100



**Eclipse Fuel Engineering Company**  
1121 Buchanan Street, Rockford, Illinois  
EXPORT: Ad Auriema, Inc.  
85 Broad Street, New York 4, N. Y.





## Modern "One-Hoss Shay"

Remember "The Wonderful One-Hoss Shay"? It ran for 100 years, each part wearing so evenly with the others that all disintegrated at the same instant!

Uniformity of wearing qualities is a key characteristic of Morris Pumps. Witness the worn-out impeller from a Morris Type K pump at right. The vanes are uniformly worn to less than  $\frac{1}{2}$ " thickness. The suction shroud is completely gone, except for a paper-thin portion little larger than a hand.

Yet the retention of original vane contour maintained hydraulic performance at normal levels, so that only a routine overhaul revealed the extent of overall wear.

Durability and dependability over the long pull are the *normal achievements* of Morris Pumps. They are the result of proper design backed by superior materials, careful engineering, and fine workmanship.



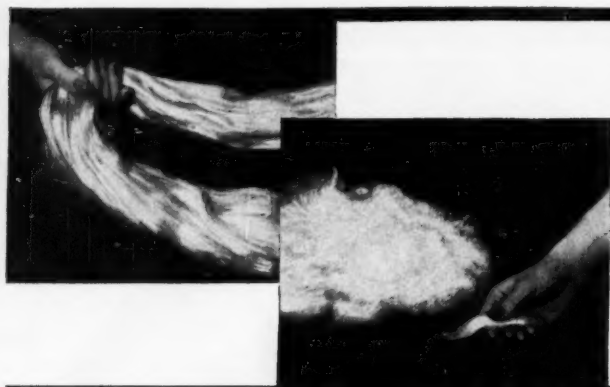
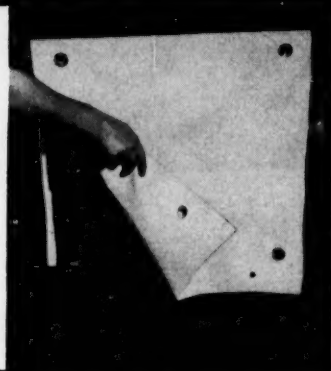
• Why not call on our engineers for qualified recommendations of pumps you can depend on for years of uninterrupted service.



**MORRIS MACHINE WORKS    BALDWINVILLE, N.Y.**

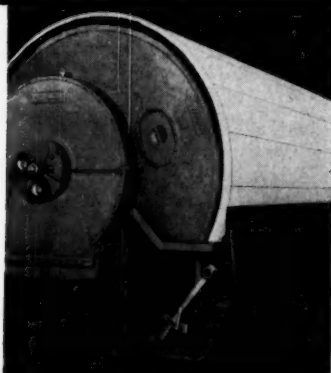
# FILTER FABRIC QUIZ

1. Where cloth must be pierced to accommodate the fittings on certain filter presses, care must be taken that the cloth will still fit the fixture, after use. In this regard, pre-shrinking is to cotton fabrics what \_\_\_\_\_ is to synthetic cloths.



2. True or false: characteristics of synthetic fabrics are practically the same whether they are made from staple or filament fibers.

3. True or false: vacuum drum filters can generally use lighter weight fabrics than pressure filters.



Knowing where to get the information and help you need, when you need it, is lots easier than trying to be both a processing engineer and a textile technician. Wellington Sears people and the filter specialists who distribute our fabrics are always ready to help with your filter cloth problems. Call us, and for some more handy information, write Dept. L-3 for our "Filter Fabric Facts."

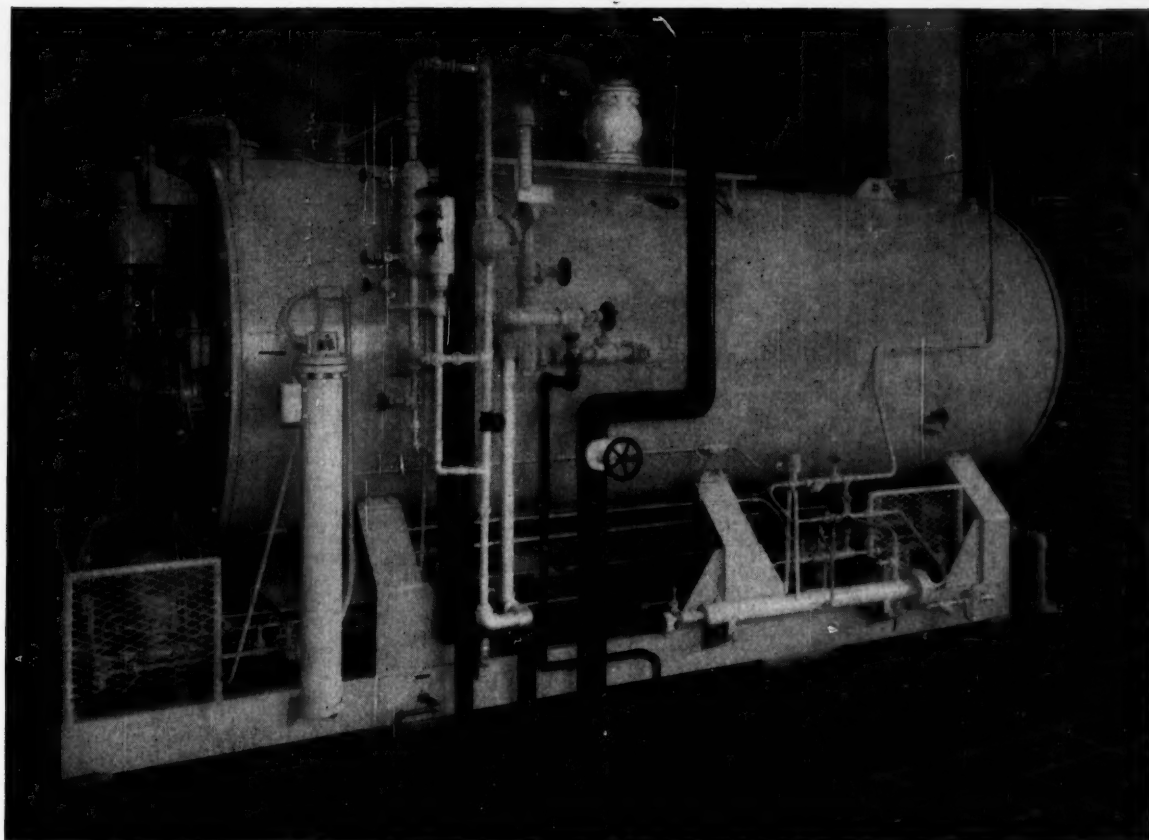
Turn page upside down for answers:

- 1. heat-setting
- 2. false
- 3. true



**WELLINGTON SEARS** *FIRST In Fabrics For Industry*

Wellington Sears Co., 111 West 40th Street, N. Y. 18, N. Y. Atlanta • Boston • Chicago • Dallas • Detroit • Los Angeles • Philadelphia • San Francisco • St. Louis



200 HP AMESTEAM GENERATOR Installation at U. S. Concrete Pipe Co.

## **LOW COST STEAM DELIVERED BY AMESTEAM GENERATORS BRINGS REPEAT ORDERS FROM U. S. CONCRETE PIPE**

Why is it that AMESTEAM GENERATOR customers are almost always repeat customers? The reason can be summed up in these words: "Lower Cost Steam". One of these repeat customers is U. S. Concrete Pipe Co., Relay, Md. This firm is one of the leading producers of large concrete drainage pipe and allied products.

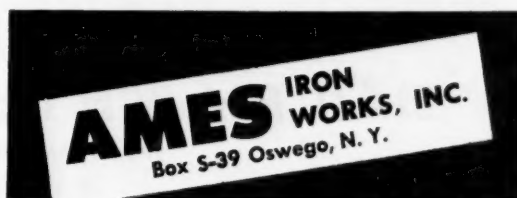
Recently the company needed a boiler to supply steam for the structural curing of various concrete products. Successful experience with the AMESTEAM GENERATOR "Package" Boilers proved elsewhere in other plant operations led

to selection of the 200 HP unit shown above. U. S. Concrete Pipe found that this AMESTEAM GENERATOR provides the most economical and efficient solution to this important steam problem.

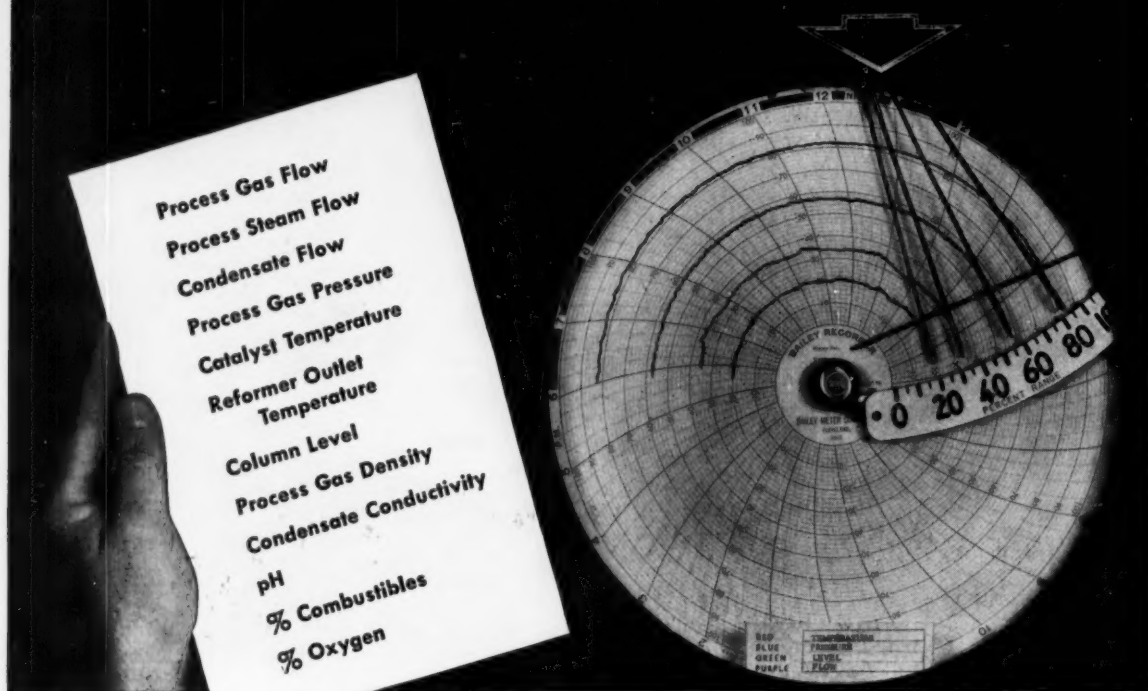
Here is another of the hundreds of users whose complete satisfaction with AMESTEAM's low-cost, dependable performance is indicated by the repeat orders we continue to receive from them. This record for repeat orders is based on AMESTEAM GENERATOR's reputation for *Low Cost Steam*, faithfully delivered over a long period of years.

### **What's YOUR Steam Problem?**

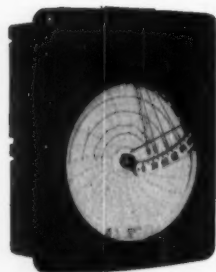
If you need 10 to 600 HP and want the kind of space-saving, trouble-free service enjoyed by satisfied owners of AMESTEAM GENERATORS, write today for our catalog and the name of your nearby Amesteam Dealer.



**Record any 4 on 1 chart!**



## To give your operation "FOUR-IN-ONE" efficiency... The BAILEY Receiver Recorder-Controller!



Records four variables on one chart.

You can lower the cost of your equipment investment and increase the efficiency of your entire operation with the Bailey Receiver Recorder.

### HERE'S HOW

The interchangeable components for the Recorder make it fast, inexpensive, and automatic to do up to *four* measuring jobs at the same time with either or both pneumatic and electric systems.

This Bailey unit continuously and simultaneously records four variables on the same

chart. And, they are in the *same linear scale measurement*. You have clear, easy-to-read records for continual analysis and control.

Plug-in, pre-calibrated receivers can easily be adapted on-the-job to revised process requirements. The Bailey Receiver Recorder saves you money with a minimum instrument investment for process cycle expansion or alteration. Let your local Bailey engineer suggest applications to fit your operation. Or write for specific control systems information for your entire plant operation.

CPI05-1

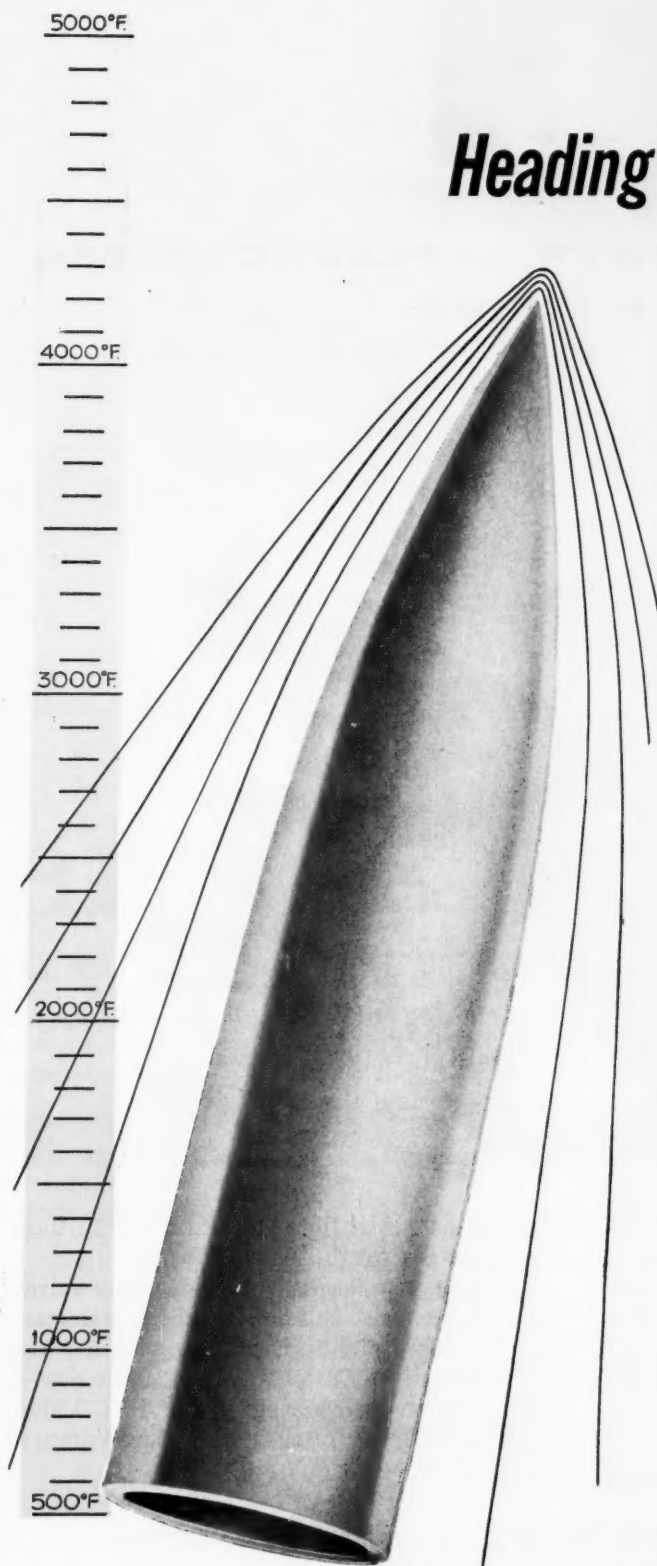
**Chemical and petroleum division**  
**BAILEY METER COMPANY**

1054 IVANHOE ROAD • CLEVELAND 10, OHIO

In Canada—Bailey Meter Company Limited, Montreal







# Heading for the unknown?

## Check your processing requirements against Norton Fused Zirconia

You can't predict tomorrow's processing requirements. However, you can be prepared to meet many of them more efficiently and economically . . . with Norton Lime-Stabilized Fused Zirconia.

### Consider Its Unusual Characteristics

Extremely high melting point (4,620°F) coupled with a lower thermal conductivity than standard dense refractories • Excellent resistance to thermal shock and abrasion • Not wet by most metals • Moderate electrical insulator at low temperatures and conductor above 2,200°F • Good stability in either oxidizing or reducing atmospheres.

### Consider Its Many Applications

As potential material for use in missiles and reaction motors • As a support for firing highly-reactive titanates • As lining for furnaces containing high temperature gaseous reactions • For furnace parts and linings used in the metals industry • As lining and packing media for high temperature air heaters and heat exchangers • For many other critical processes.

Chances are you can improve both your processing and your production economy with this rugged, versatile material. Let a Norton Sales Engineer help. He's well qualified to discuss your precise requirements. Write to NORTON COMPANY, Refractories Division, 502 New Bond Street, Worcester 6, Mass.

**Note:** Norton Lime-Free Fused Zirconia is also available for the manufacture of refractories, as a source material for zirconium for chemicals and metals, or as an opacifier for glazes and enamels.

Melting Point . . . . .	4,620°F
Maximum Usable Temperature . . . . .	4,450°F
Chemical Nature . . . . .	Stable
Electrical Resistivity . . . . .	High Temperature Conductor
True Specific Gravity . . . . .	5.6 — 5.7
Two Grain Types . . . . .	Hard Dense Grains Bubble-Type Grains

**NORTON**

REFRACTERIES

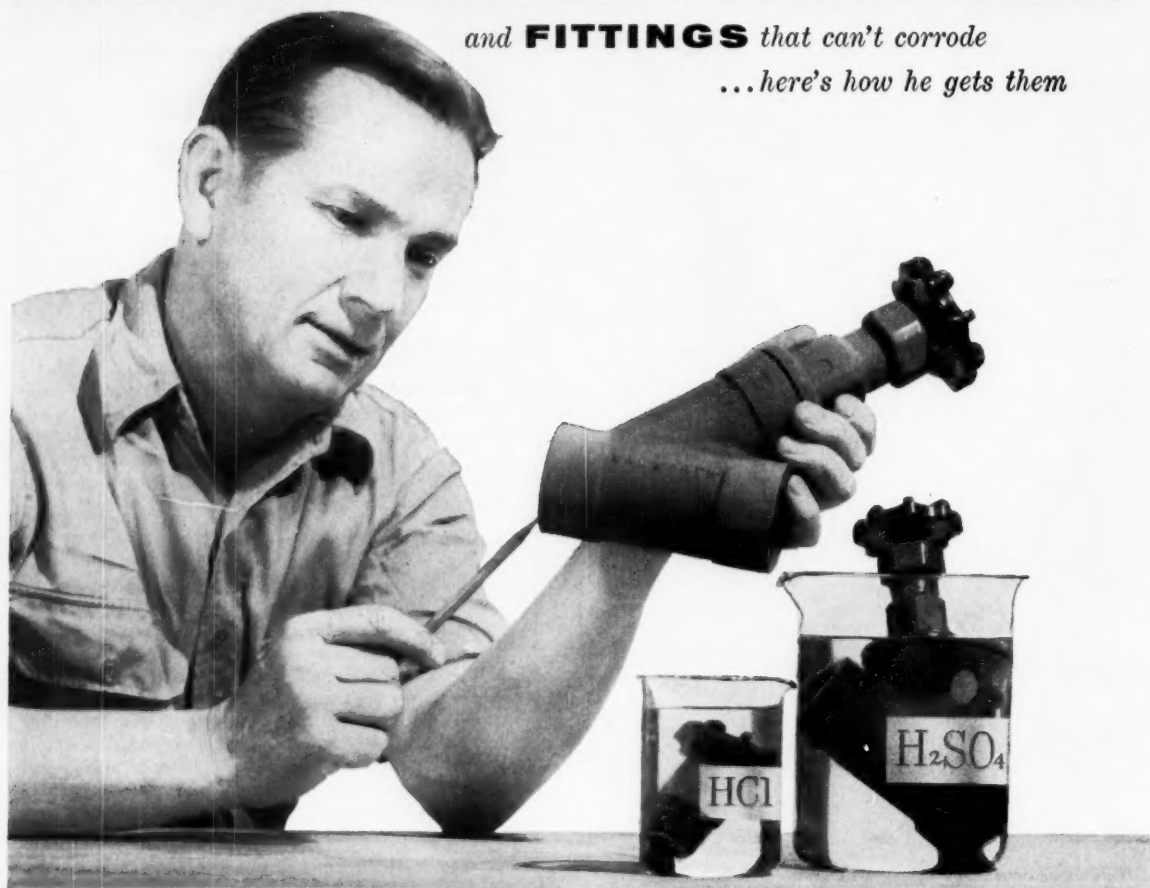
Engineered...  $R_x$  ...Prescribed

**Making better products . . . to make your products better**

NORTON PRODUCTS Abrasives • Grinding Wheels • Grinding Machines • Refractories • Electrochemicals — BENR-MANNING DIVISION Coated Abrasives • Sharpening Stones • Pressure Sensitive Tapes



*the* **WALWORTH CUSTOMER** *wants* **PLASTIC VALVES**  
*and* **FITTINGS** *that can't corrode*  
*...here's how he gets them*



When the Walworth Customer is faced with the control of corrosive fluids, he looks at dozens of plastic valves and checks them for himself. He demands answers to questions like these: Can this valve corrode? Is it toxic? Is it non-aging? In Walworth PVC Valves and Fittings, the Walworth Customer finds his answers. Not only is PVC nontoxic and non-aging, — it *can't* corrode. All parts are made of plastic. Valves and

fittings have high burst strength. Given those facts the Walworth Customer buys.

That may be the way you like to buy valves, too. If you insist on knowing about materials, workmanship and high quality, we'd like you for a Walworth Customer, too. For the newest literature on the complete line of PVC Valves and Fittings, get in touch with your Walworth Distributor.

Or write **WALWORTH** 750 Third Avenue, New York 17, N. Y.  
 DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

**WALWORTH SUBSIDIARIES:** ALLOY STEEL PRODUCTS CO. • CONOFLOW CORPORATION • GROVE VALVE AND REGULATOR CO.  
 M&H VALVE & FITTINGS CO. • SOUTHWEST FABRICATING & WELDING CO., INC. • WALWORTH COMPANY OF CANADA, LTD.



# BREAKTHROUGH<sub>2</sub> in oxygen measurement!

Now you can measure oxygen concentration simply, quickly, accurately with this new direct meter reading instrument from MSA.

The M-S-A® Portable Oxygen Indicator puts the finger on oxygen deficiency and hazardous oxygen leakage. In purging gas transmission lines or process systems of air, this precision instrument can be used to determine rate of progress.

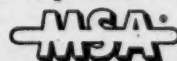
You can also use it to do a number of other jobs that could never be done in the past. Take spot checks of inert atmospheres. Solve problems of combustion control. Measure oxygen content of flue gases. Guide the proper proportion of fuel and air.

The M-S-A Portable Oxygen Indicator measures oxygen in *gaseous mixtures* at location of sampling line inlet, at time of tests. Simplicity of design

makes it easy to operate, convenient to use, and a snap to service. Large meter scale can be read at a glance. 0.5% accuracy.

An accessory liquid trap guards against condensation of water vapor from high temperature samples. An accessory scrubber containing chemisorbent is available to guard against strongly acid gases. Entire instrument is housed in rugged aluminum case only 6¼" x 4½" by 5¾" high. Sampling lines of various lengths are available. Weighs only 5¼ lbs.

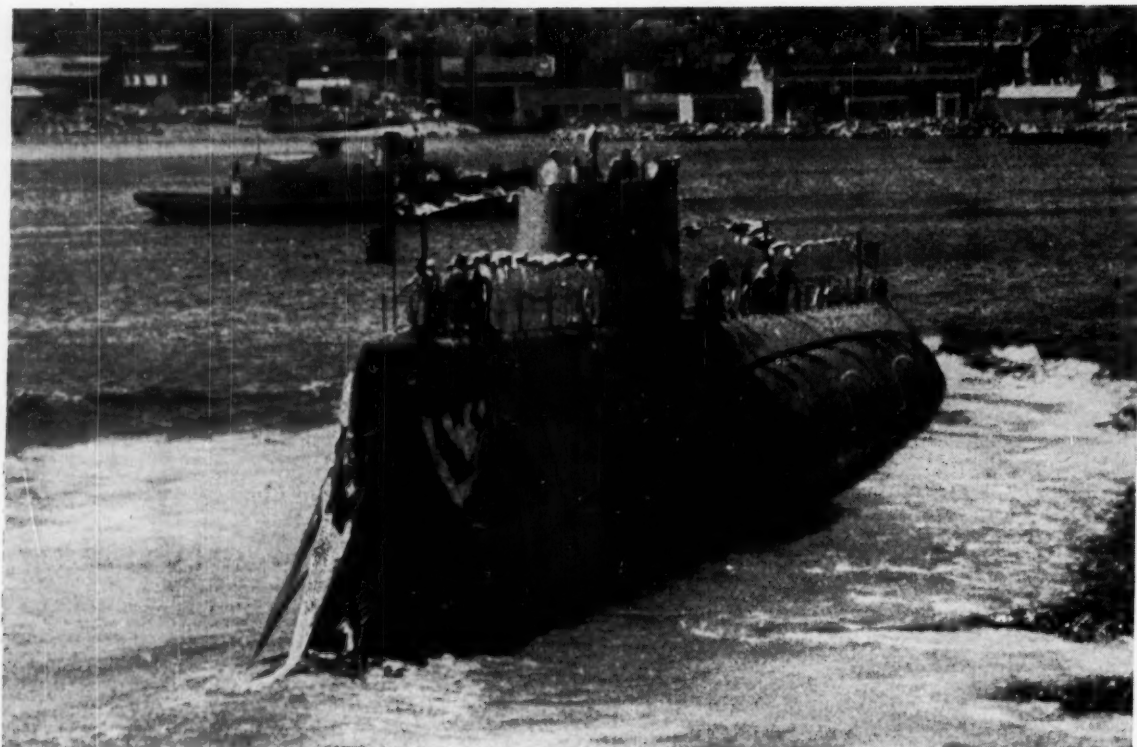
The versatility of such an instrument could add a big boost to the efficiency of your operation. Another consideration is the extra margin of safety it provides for work crews. Ask the MSA Representative for a demonstration, and write MSA for a descriptive bulletin.



**INSTRUMENT DIVISION  
MINE SAFETY APPLIANCES COMPANY**

Pittsburgh 8, Pennsylvania





## ***Triton*, Navy's Largest Nuclear Sub, Uses Bridgeport Condenser Tubes**

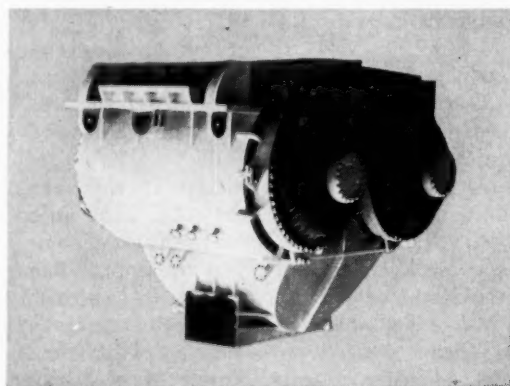
Launched in August, 1958, the U.S.S. *Triton* is the biggest, most powerful submarine ever built. With a length of 447 ft. and a displacement of 5,900 tons, *Triton* boasts, among other things, of two engine rooms and two reactor compartments. Built by the Electric Boat Division of General Dynamics Corporation, she is truly a major achievement in naval architecture.

Naturally, *Triton's* equipment must meet the most rigid operating requirements. Helping to fulfill these requirements are Bridgeport Cupro-Nickel condenser tubes in the Allis-Chalmers condenser and air ejector equipment.

Meeting operating demands such as *Triton's* has long been standard practice at Bridgeport. Outstanding operating records have been—and are being—achieved regularly. The experience and knowledge gained from these records can be put to your use—whenever you wish to take advantage of them.

Whatever your needs—simple retubing or other requirements—they are best served, in every respect,

by Bridgeport. If you have any problem, question or plans involving heat exchanger equipment, on land or at sea, call your nearest Bridgeport Sales Office. For full details, write direct for the 162-page Bridgeport Condenser Tube Handbook. Write Department 5003.



*These twin condenser units were designed and built by Allis-Chalmers. Bridgeport tubes were used throughout.*



## **BRIDGEPORT BRASS COMPANY**

Bridgeport 2, Connecticut • Sales Offices in Principal Cities

*Specialists in Metals from Aluminum to Zirconium*



**Don't wait 'til next spring!**



If you are contaminating your plant water supply,  
it will be worse during the hot months of 1959  
Here is your solution — the Graham  
**CAPTIVE WATER COOLANT UNIT**

The Graham Captive Water Unit condenses your contaminated process vapors without carrying foreign material into your plant water supply. The Graham Captive Water Unit condenses all your noxious vapors with its own independent water supply. This water supply in itself is cooled in the flash cooler section of the unit and thereby allows these foreign materials to be removed from the system without troubles.

We call your attention to the unit shown here and suggest that you investigate this unit for your

**Deodorizers**  
**Petroleum Refinery Vacuum Units**  
**Vacuum Acid Concentrators**  
**Paper Mill Vacuum Evaporators**  
**Fish Stick Liquor Evaporators**  
**Evaporated Milk Vacuum Pans**  
**Urea Process Evaporators**  
**Food Process Evaporators**  
—and many others.

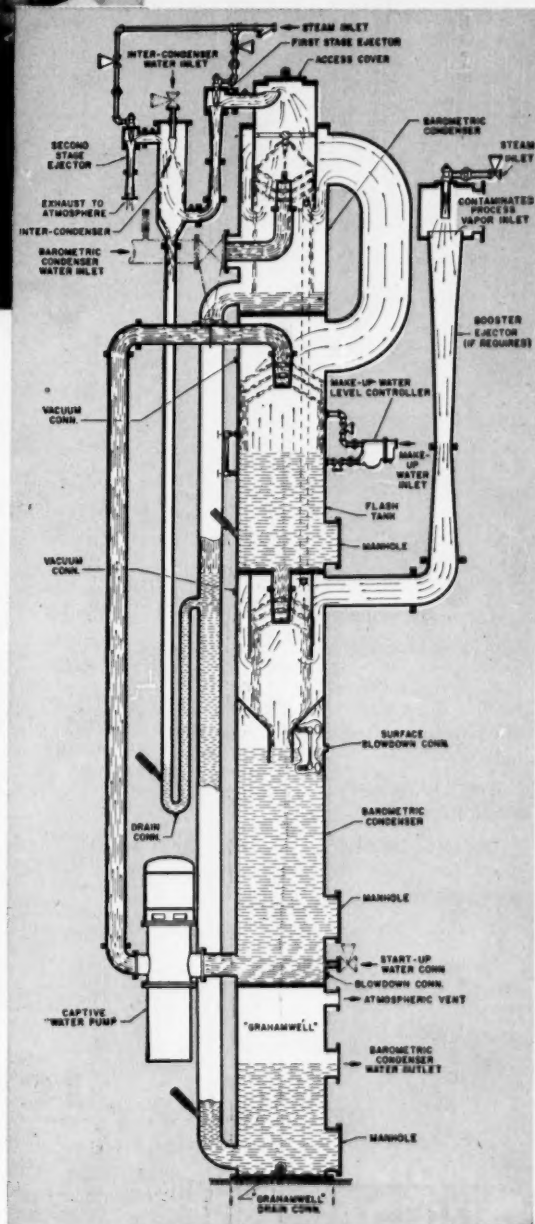
For trouble free operation without continuous maintenance consult us on your contaminated vapor problems and the Graham Captive Coolant Condenser.

**GRAHAM MANUFACTURING CO., INC.**

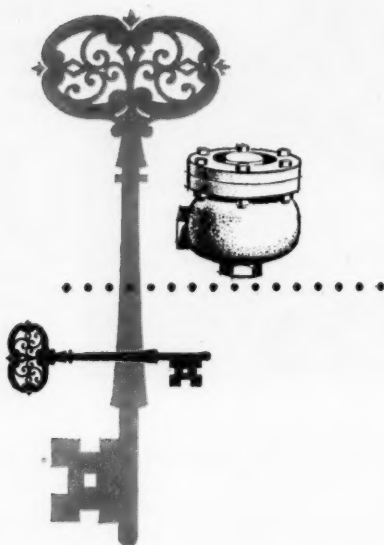
**Heliflow Corporation**

415 LEXINGTON AVE., NEW YORK 17, N. Y.

Offices in principal cities and Canada



# Who Holds the Key in Turnkey?



Not the consulting engineer.

Not the prime contractor.

Not the subcontractors.

Not even the customer's representative who, assigned to build a plant and stay within the building budget, is too often willing to forfeit the future for a good cost showing today.

The key to this plant's productivity and profits is held solely by the *owners*.

The owners must, of necessity, think in terms of how much this plant will produce, and at what cost. They must, of necessity, think of *total cost*.

*Total cost* includes the price of original equipment, the

expense of installing it, and how much it costs to maintain it over the entire useful life of the plant.

Take steam traps, for example. Lots of traps cost less than Nicholson's. In a box on the jobber's shelf, that is.

But when the plant *owners* have paid the cost of installation, and "dry, clean steam" has been contaminated by everything from weld bead to broken beer bottles and the *owners* have paid the cost of that, and finally when the "bargain" traps have broken down in service—the *owners* call on Nicholson.

Quality Nicholson steam traps, sometimes higher in initial cost but always lower in installed cost, have long enjoyed the reputation of being the *owners'* favorite—the favorite of the people who, in the long run, have to pay the bill.

ST-100

**N**  
**NICHOLSON**  
OF WILKES-BARRE  
W. H. Nicholson and Co. • 16 Oregon Street • Wilkes-Barre, Pa.  
Distributors in all principal cities

# LINDE packaged oxygen plant sets nine-year record for availability!

THE LINDE oxygen plant shown here has been serving a leading chemicals producer "over-the-fence" continuously since 1949. Its operating log shows a 98%+ availability factor. Next year, capacity will go up from 360 to 800 tons of oxygen a day.

You can expect the same continuity of supply with a LINDE packaged plant serving your process. Your LINDE plant will be the product of fifty years' experience in the design, manufacture, and operation of air separation plants and low temperature equipment. LINDE is uniquely qualified to provide air separation plants for the supply of oxygen and/or nitrogen as well as the associated low temperature equipment for:

liquefying hydrogen, helium and fluorine

purifying hydrogen and helium

separating hydrogen from coke oven gas

ammonia and methanol synthesis

upgrading of natural gas

other extremely low temperature processes.

Put LINDE's more than 50 years' experience in gas separation techniques to work for you. Write Dept. CG-32, LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N.Y. In Canada: Linde Company, Division of Union Carbide Canada Limited.

"Linde" and "Union Carbide" are trade-marks of Union Carbide Corporation.

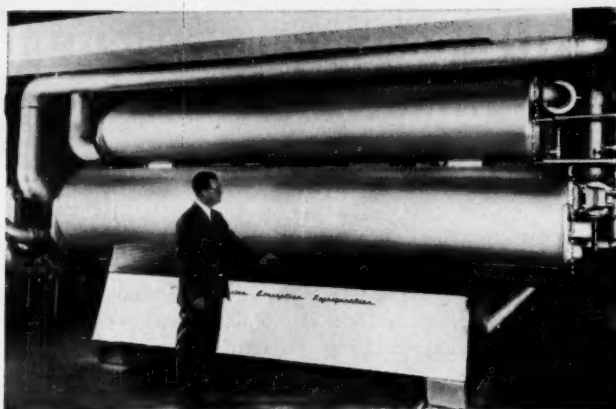


*Linde*  
TRADE-MARK

Industries that regularly require large quantities of oxygen or other atmospheric gases can obtain those they need from a LINDE plant on their own sites. The oxygen plant illustrated—built, owned, and operated by LINDE—is at a plant of one of the nation's largest chemical processors.

**UNION  
CARBIDE**

For reliable cooling  
from low-cost heat



## 29 leading U.S. chemical producers use Carrier Absorption Refrigeration

In the last seven years 29 leading U.S. chemical companies have purchased Carrier Absorption Refrigerating Machines. They deliver a total of 19,470 tons of cooling, range in capacity from 60 to 700 tons and help produce such varied products as baby powder, explosives, table salt and vinyl plastics.

Why have these companies chosen Carrier Absorption Refrigeration—and why have so many of them become repeat buyers? One reason: economy. Cooling produced by low-pressure steam or hot water is often the best way to handle refrigeration requirements in a processing plant. Another reason: reliability. For years Carrier Absorption Machines have established an unmatched record for dependability in more than 1000 installations throughout the world.

Of course, there are other reasons. So the next time you need refrigeration, why not call Carrier and get the whole story? Call your nearest Carrier office. Or write Carrier Corporation, Syracuse 1, New York.

BETTER AIR CONDITIONING FOR EVERYBODY



EVERYWHERE

Automatic **STOP-and-GO** is just one of many features of the Carrier Absorption Machine. No valves to turn, no switches to throw. Just a single push button for "Stop-and-Go." The human element can be eliminated altogether by use of a time clock or thermostat.



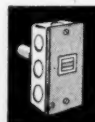
#### Push Button

Starts and stops the machine at the press of a single button.



#### Time Clock


Automatically starts or stops machine at any hour you select.



#### Thermostat

Automatically starts or stops machine at desired temperature.





NO LEAKAGE  
NO PRIME LOSS  
NO CONTAMINATION  
NO STUFFING BOX

End  
Liquid Metering  
Problems  
with a  
**Lapp**  
**PULSAFEEDER**  
CONTROLLED-VOLUME  
CHEMICAL PUMP

**WRITE FOR BULLETIN 440**

*with typical applications, flow charts, description and specification of models of various capacities and constructions. Inquiry Data Sheet included from which we can make specific engineering recommendation for your processing requirement. Write Lapp Insulator Co., Inc., Process Equipment Division, 3607 Poplar Street, LeRoy, N. Y.*

● Precise metering, pumping, proportioning and feeding of hard-to-handle chemicals is the specialty of the Lapp PULSAFEEDER. Designed for accurate handling of corrosive and non-corrosive liquids, it is a combination piston-diaphragm pump... providing positive displacement with *no stuffing box*. Leakage or contamination of the liquid being pumped is prevented by a hydraulically balanced diaphragm isolating the liquid from the pump's drive mechanism. All pump parts contacting liquid are of special corrosion-resistant materials. Pumping speed is constant; variable flow results from variation in piston-stroke length, controlled manually by hand-wheel, or, in auto-pneumatic models, by instrument air pressure responding to any instrument-measurable processing variable.

**Lapp**

# Kathabar® systems eliminate wet floors, walls, equipment, and products !



Think what it would mean to you if you could eliminate condensation and its corrosion problems from plant processing and storage areas, and keep work spaces dry even when they're hosed down regularly for sanitation.

Maintenance savings alone would improve your profit picture for the year. Increased life of your structures and equipment would pay long-term dividends. Storage losses from condensation would be a thing of the past.

Such profits are immediately available to you in a Kathabar-engineered air conditioning system.

## let's look at cases

This sampling of Kathabar installations will show you how effective and versatile a Kathabar system can be.

### waterworks case

Pipe galleries in a huge waterworks are completely surrounded by water as cold as 40 F. A Kathabar system maintains the air at below the water dew point, year-round, and eliminates condensation. This system paid for itself in less than three years.

### brewery case

In the new cellars of a large midwestern brewery, a Kathabar system is earn-

ing profits by eliminating condensation. Washdowns are less frequent; dry cellars curb bacterial growth. As a bonus benefit, the Kathabar system delivers the air at a maximum count of 4 Bertratia Mercescens per cubic foot when the air entering the unit contains 40.

### candy case

A candy manufacturer was plagued by condensation on the cooling slabs in his enrobing room. The moisture made his conveyor belt expand and jam. Chocolate and starch dust gummed up the belt and stopped production. A Kathabar system not only eliminated these problems, but increased production by 25%.

### marine case

Kathabar systems in cargo ships and tankers provide anti-corrosion control, protection against cargo contamination, and ready gas freeing of all tanks. Kathabar systems quickly amortize themselves in maintenance savings, longer bulk-head life, better cargo protection, and faster turn-around.

### other cases

Consulting engineers combine radiant panel cooling with Kathabar systems to dehumidify fresh air makeup. Colder water can be used in the panels, increasing efficiency without the danger of condensation.

Unitized Kathabar systems, using only electric power, dehumidify government storage caves. Completely portable, they are readily spotted to keep the dampest areas bone dry. Individual units avoid the fire hazard of a central system.

## who uses Kathabar systems

Kathabar systems make profits out of air for these industries:

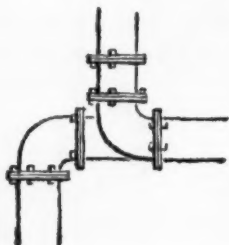
Atomic Energy	Machining
Breweries	Marine
Cake Mix	Matches
Candy	Meat
Cellophane	Offices
Cellulose	Ordnance
Cereals	Paper
Chemicals	Pharmaceuticals
Coffee	Plastics
Comfort	Printing
Compressors	Rockets
Cookies	Rubber
Electronics	Sanitaryware
Explosives	Shellac
Film	Sugar
Foundries	Testing
Gelatin	Textiles
Glass	Transformers
Glue	Transistors
Gum	Vacuum Tubes
Hospitals	Varnish
Hotels	Waterworks
Lacquer	Wire
Lenses	Yeast

## how they use Kathabar systems

Many of these industries use Kathabar systems for eliminating condensation. Others use them to (1) obtain continuous air at sub-freezing dry bulb and dew points; (2) maintain spaces below 80 F and 55% RH; (3) maintain spaces at specific low bacteria or mold count; and (4) improve drying processes.

## send description of your problem

Air Conditioning and Drying Division  
SURFACE COMBUSTION CORPORATION  
2380 Dorr Street Toledo, Ohio

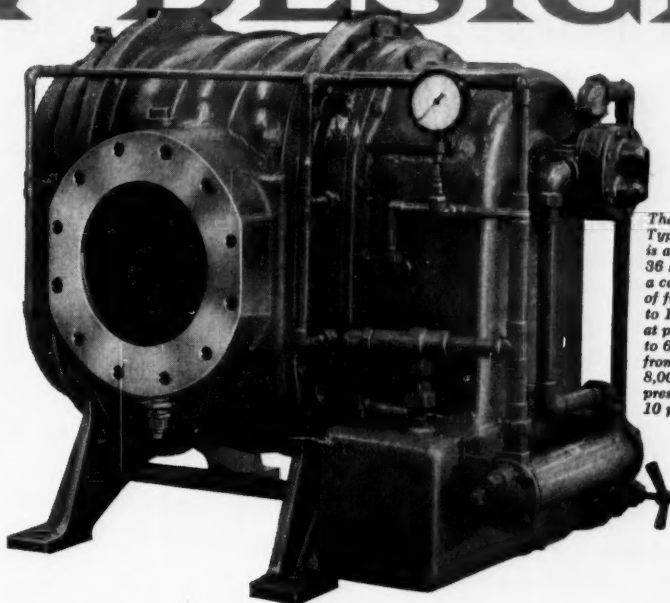


Kathabar systems by



# NEW-DESIGN

R-C  
blower  
delivers  
more  
CFM



The new R-C Type RAS Blower is available in 36 sizes covering a capacity range of from 3,000 to 14,000 cfm at pressures to 6 psig and from 1,500 to 8,000 cfm at pressures to 10 psig.

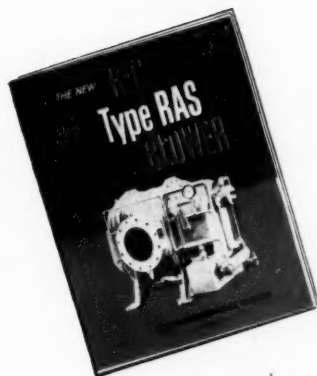
## AT LOWER POWER COST

A new, high-performance R-C rotary positive blower (designated Type RAS) features two important design improvements. *First*, a new "segment waist" impeller contour that increases the volumetric efficiency of the blower. *Second*, a new vertical arrangement of the impellers that increases application flexibility.

The design of the "segment waist" impeller contour permits a higher pressure rating for a given impeller length. This in turn delivers greater displacement per revolution without increasing operating speed and at a lower power cost. And, in addition to being more quiet in operation, the design permits safe handling of entrained liquids.

The vertical arrangement of the impellers provides horizontal inlet and discharge connections for more convenient, simplified piping. Extremely compact, the blower also offers substantial savings in space requirements. And, as with all R-C rotary positive blowers, air delivered is free from oil vapors and other contaminants.

Roots-Connorsville RAS blowers offer many advantages—exclusive rotary positive design, ease of installation, efficiency of operation, and long years of trouble-free service. These features are the result of R-C's specialized experience of more than 100 years in the design and application of air and gas handling equipment.



For additional data, please refer to pages 565-568 in Chemical Engineering Catalog, our section in Mechanical Catalog, or write for Bulletin RAS-158.

For gas service too... This same new design is also available in pumps for gas service. Designated Type RGS, the gas pumps differ from Type RAS Blowers only in that a mechanical face type seal is used instead of a lip seal.



### ROOTS-CONNERSVILLE BLOWER

DIVISION OF DRESSER INDUSTRIES, INC.

359 Illinois Ave., Connorsville, Indiana. In Canada—629 Adelaide St., W., Toronto



## Teflon-lined pipe helps plant save \$60,000 per month... enables corrosive process to stay on stream

**Problem:** Excessive maintenance costs and product losses ran as high as \$60,000 per month during first six months' operation of process at a major chemical plant.

The process for the manufacture of a chemical intermediate involves handling hydrochloric acid and organic liquids at temperatures exceeding 275°F. In the past, the highly corrosive properties of this combination had restricted material of construction to non-metals.

Laboratory work established that many potential advantages could be obtained by increasing operating pressure from a normal level up to several atmospheres. However, a new material of construction would be required for the high pressure service.

An exhaustive search for satisfactory piping materials included a number of alloys, plastics, and other types of materials. The most promising of these were installed. In spite of this program, such frequent failures occurred that on-stream time averaged only 75% during the first six months' period of operation.

**Solution:** It was found that two experimental lengths of steel pipe lined with Teflon TFE-fluorocarbon resin had been placed on test previously. Both had provided excellent service for 24 months at 230°F and 10 psig. Both were then reinstalled in the new pressure system and were in operation for several more months without failure.

Based upon this and other encouraging results, conversion to steel pipe lined with TFE resin began as soon as it became commercially available. Plant now has more than 1500 feet of the lined pipe in service. Most of it is of 2" size although some up to 6" in diameter is in use. More than 400 Teflon TFE-fluorocarbon lined fittings are in use at the plant.

**Results:** No failures of the lined pipe have occurred. Some of it has already been in service more than 15 months. Outstanding performance of the lined pipe under the severe conditions has been a major factor in saving the \$60,000 per month that was being lost through excessive maintenance and loss of product. Use of the lined pipe promises to make the process as reliable as those with no special materials of construction problems.

NOW  
OVER  
2  
YEARS

In the petroleum industry, pipe lined with Teflon has been found to be quite useful for handling hydrofluoric acid at elevated temperatures and pressures. Lined pipe has also proved valuable in chlorination, sulfonation, and nitration processes. Method used by manufacturer for lining pipe compensates for thermal expansion of liner to the extent that fatigue problems and reduction in flow diameter are eliminated.

(Fluoroflex-T pipe and fittings lined with TFE-Fluorocarbon resin are manufactured by RESISTOFLEX CORPORATION, Woodland Rd., Roseland, N. J.)


Reprinted with permission of CHEMICAL PROCESSING

Complete systems for corrosive service  
**Resistoflex**

ROSELAND, NEW JERSEY · WESTERN PLANT: BURBANK, CALIF. · SOUTHWESTERN PLANT: DALLAS, TEX.

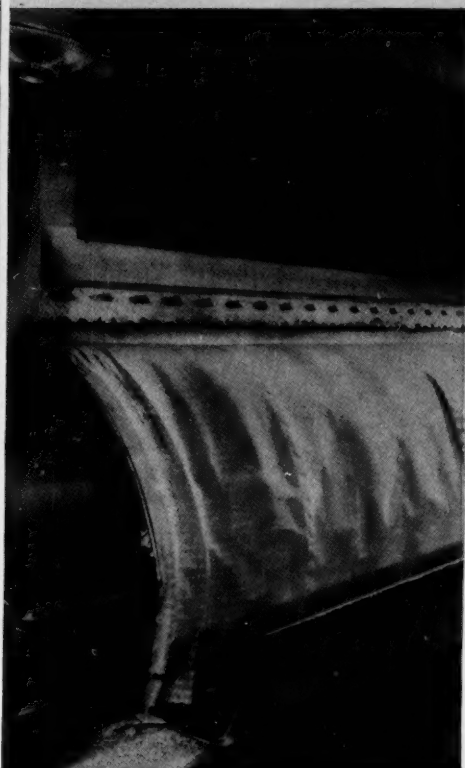
See the best in Teflon at the Resistoflex booths #2, 3, 4 at the NACE Show in Chicago.





Pastes and sludges of varying viscosities are handled rapidly and economically by continuous drum drying.

Molten materials, often repelled by smooth drum surfaces, are successfully flaked on grooved drums.



Heavy or dilute liquids respond well when dried on equipment specifically designed for the process.

## How Buflovak Drum Dryers are tailored to improve your product . . . boost your profits

Whether you need a single drum dryer to handle simple solutions at low cost . . . an enclosed drum dryer to process toxic materials . . . a double drum vacuum dryer to protect heat-sensitive liquids, Buflovak builds the dryer to best meet your needs.

Five different types of drum dryers are just part of a complete line that includes atmospheric and vacuum types, with chamber, pan, rotary, spray and other models.

Backed by this complete line, Buflovak experienced engineers can *impartially* recommend the unit that meets known specifications . . . fulfills the requirements of individual product testing.

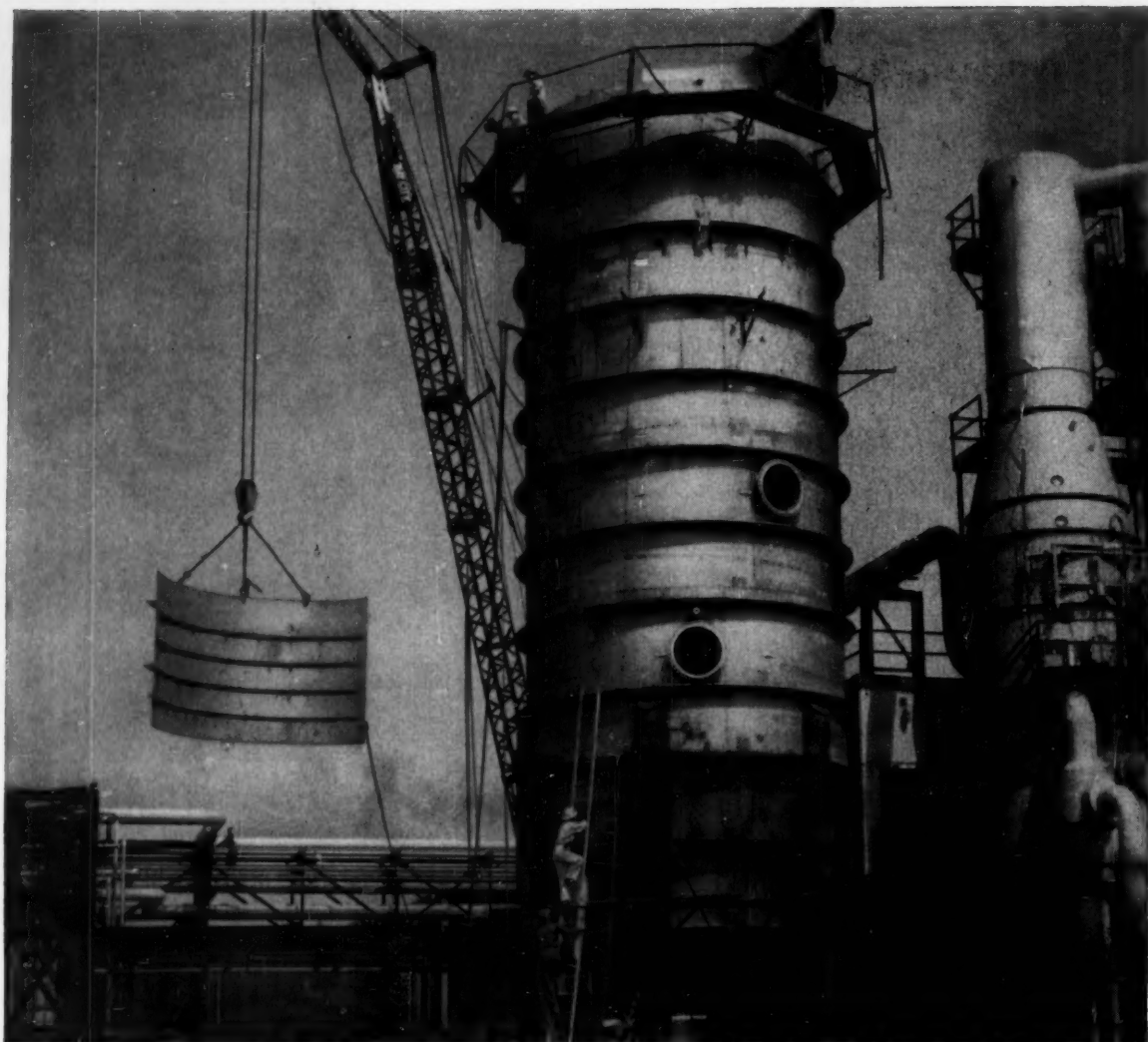
### Select your dryer scientifically at the Buflovak Customer Service Laboratory

An extensive line of small scale and pilot-size equipment is at your service for investigating drying, evaporation, extraction, impregnation and crystallization problems. Here you obtain accurate data and actual samples of your processed product, examine operation efficiency . . . thoroughly explore by-product possibilities.

Catalog 384 describes the Buflovak Dryer line; Catalog 381 fully describes Buflovak's lab. Both are available at your request. Additional facts also available in C. E. Catalog, pages 429 to 452.



**BLAW-KNOX COMPANY**  
Buflovak Equipment Division  
1551 Fillmore Avenue, Buffalo 11, New York



Building the world's largest crystallizer for production of ammonium sulfate fertilizer at the National Aniline Division of Allied Chemical Corporation

in Hopewell, Va. The unit was designed and fabricated of Allegheny-Ludlum Type 316 stainless steel by Struthers Wells Corporation of Warren, Pa.

## World's largest continuous sulfate crystallizer combats corrosion with Type 316 stainless steel

Nickel-containing Type 316 stainless steel is counted upon to defeat sulfuric acid attack in this huge ammonium sulfate crystallizer. Said to be the world's biggest (150 tons, 82 feet high, 20 feet diameter), the crystallizer will produce about 200 tons of controlled-size crystals daily.

Nickel-containing stainless steels also balk sulfuric acid attack else-

where in the ammonium sulfate process — pumps, lines, centrifugal separators.

**Good hot or cold!** Austenitic stainless steels provide ample strength to 1200° F, ample toughness down to -300° F. They resist combinations of heat, abrasion, and corrosion.

In hundreds of chemical processes,

the austenitic stainless steels protect such equipment as columns, heat exchangers, holding tanks. When your job involves hard-to-handle corrosives, it will pay you to investigate the lasting qualities of Nickel-containing stainless steels.

**THE INTERNATIONAL NICKEL COMPANY, INC.**

67 Wall Street  New York 5, N. Y.

# INCO NICKEL

NICKEL MAKES ALLOYS PERFORM BETTER LONGER

# BRIEFS

on information about sodium chlorate  
for those interested in chlorine dioxide  
... a new drum for sulfides ... a grease  
that won't burn or corrode ... a booklet  
on trichlorethylene

## Why you should know more about sodium chlorate

You've undoubtedly been hearing a lot about chlorine dioxide—how it is an unusually effective oxidizing agent—how it imparts no taste or odor to end products.

Not nearly as much has been said about chlorine dioxide's starting point—sodium chlorate. We think this ought to be corrected, since most everyone generates the chlorine dioxide right at the use point.

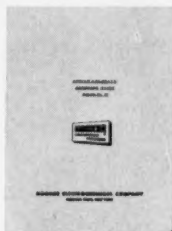
So it is we offer you a bulletin and technical data sheet.

The bulletin tells you all the accepted precautions used in handling and storing sodium chlorate. It tells how to unload a tank car and explains the operation and design of the valves used. It lists physical and chemical properties and illustrates them in a series of graphs and charts.

It also offers methods of analysis.

The technical data sheet tells why more people use more Oldbury® sodium chlorate than any other brand. A typical analysis shows this brand to be 99.8% pure. No water insolubles. No free metals.

You can get both bulletin and data sheet simply by checking the coupon.



of oxygen, hydrogen peroxide or concentrated mineral acids and alkalis; a grease that's applicable up to 200°C. (with an oil base stable to 300°C.); a grease that is odorless and non-toxic?

Yes, we are describing one grease. It's named Fluorolube®. It's a high-density polymer of trifluorovinyl chloride. It's available in many grades, ranging from low-viscosity, colorless oils to opaque greases. All are excellent lubricants.

For complete specifications and typical properties, send the coupon for our Fluorolube Data File.



## Get sulfides in new drum that empties faster, more safely

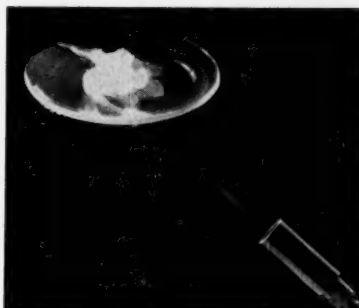
To start with, understand that you pay no extra for this new Hooker drum.

It has an 18-inch opening—four inches wider and 65% larger in area than its predecessor.

The new opening makes it much, much easier to empty either by pouring or with a scoop or shovel. It's safer to use, too. Flakes never pile up around the opening.

We use only brand-new drums; none are re-used. A lacquer lining prevents iron pick-up during shipping and storage. Six lugs hold the lid, keeping it air- and moisture-tight.

For specs on the sodium sulfide and sodium sulfhydrate that go into the drums, check the coupon.



## You can't burn this grease ... or break it down

Where could you use a grease that is completely nonflammable; a grease that won't break down in the presence

## New bulletin lists chemicals, useful data

To bring our fast-growing list of chemicals up-to-date, we've prepared a new General Products List.

Its 12 pages give you a quick reference guide to all our chemicals and services.

With each product is a condensed listing of important specifications along with information on shipping containers. All of these data are presented in table form so that you can make fast, accurate readings.

For a copy, just check the coupon for Bulletin 100-B.



For more information check here and mail with your name, title, company, and address.

- |   |   |
|---|---|
| <input type="checkbox"/> Sodium Chlorate (data sheet) | <input type="checkbox"/> Sodium Sulfide |
| <input type="checkbox"/> Bul. 99, Sodium Chlorate     | <input type="checkbox"/> Fluorolubes    |
| <input type="checkbox"/> Sodium Sulfhydrate           | <input type="checkbox"/> Bulletin 100-B |

When requesting samples, please use business letterhead to help speed delivery.

## HOOKER CHEMICAL CORPORATION

403 FORTY-SEVENTH STREET, NIAGARA FALLS, N. Y.

Sales Offices: Chicago Detroit Los Angeles New York  
Niagara Falls Philadelphia Tacoma Worcester, Mass.  
In Canada: Hooker Chemicals Limited, North Vancouver, B.C.



# BARNSTEAD

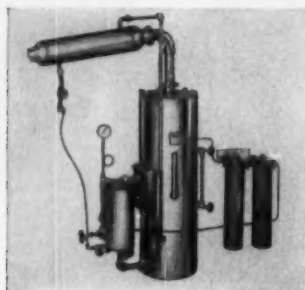
PURE WATER SPECIALISTS SINCE 1878

## WATER STILLS and DEMINERALIZERS



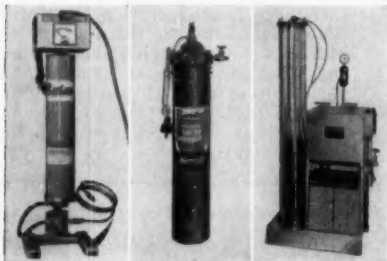
### PUREST WATER AUTOMATICALLY

Barnstead Full Automatic Controls for water stills are self-starting . . . self-flushing . . . self-stopping. No human attention needed. Automatically guarantees a steady supply of distilled water of highest purity.



### THE STILL YOU NEVER NEED CLEAN

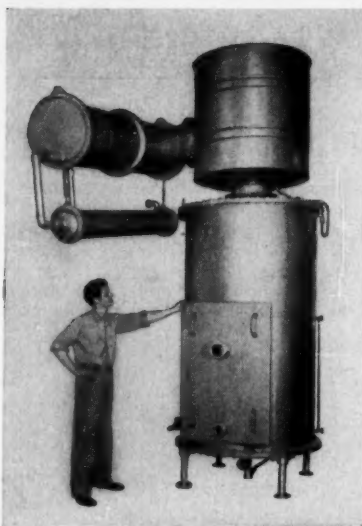
The NEW Barnstead Condensate Feedback Purifier for Barnstead Steam Heated Stills offers two important advantages. Produces distilled water of higher purity than ever before, and completely eliminates need for cleaning Still.



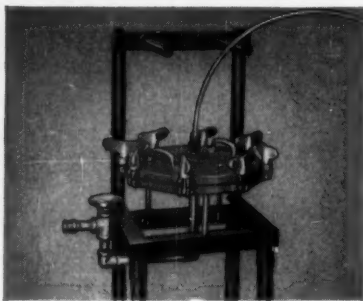
**BANTAM DEMINERALIZER (BD-1)** Connects directly to water supply. Disposable resin cartridge. Flow rate: 5 to 10 g.p.h.

**PRESSURE BANTAM DEMINERALIZER (BD-2)** Delivers demineralized water under pressure. 5 to 25 g.p.h. Pura-lite indicates cartridge change.

**MIXED-BED DEMINERALIZERS (MM)** in capacities ranging from 50 to 2500 g.p.h. Efficient and low cost in operation. Exceptionally high purity.

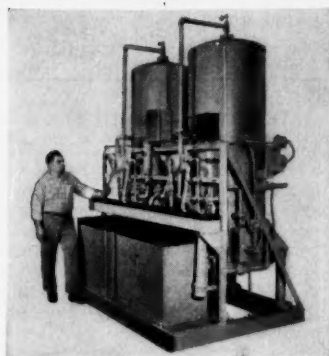


### FOR PHARMACEUTICAL MANUFACTURERS. 300 G.P.H. PYROGEN-FREE WATER PRODUCED BY THIS MODEL SSQ-300 BARNSTEAD WATER STILL



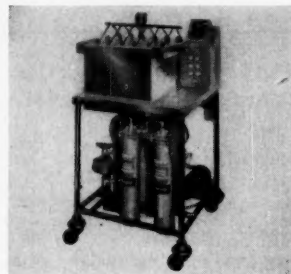
### BARNSTEAD "MF" SUBMICRON FILTER FOR REMOVAL OF PARTICLES TO 0.45 MICRON

For either distilled or demineralized water . . . removes particulate matter which may cause trouble in some of the new processes in electronic and nuclear fields. Filters out particles as small as .000016 inches. Produces 15,000,000 ohm water in production quantities.



### DEMINERALIZED WATER AT FLOW RATE OF 2500 G.P.H.

is produced by this Barnstead Model TM-6, Two-Bed Demineralizer. Complete package unit, factory assembled, ready to connect to raw water supply. Also Mixed-Bed, Single-Bed, Two-Bed, and Four-Bed Models. Write for catalog 127-A.



### BARNSTEAD TRANSISTOR WASHER FOR WASHING TRANSISTORS, DIODES, RECTIFIERS, TUBE PARTS IN ULTRA PURE 15,000,000 OHM WATER

Faster rinsing and fewer rejects when hot, ultra-pure water is used in rinsing of electrical components. Barnstead Transistor Washer conserves thousands of gallons each day . . . as it repurifies the pure, hot water keeping it free of organic impurities and submicroscopic particles to 0.45 micron. Write for Bulletin #146.

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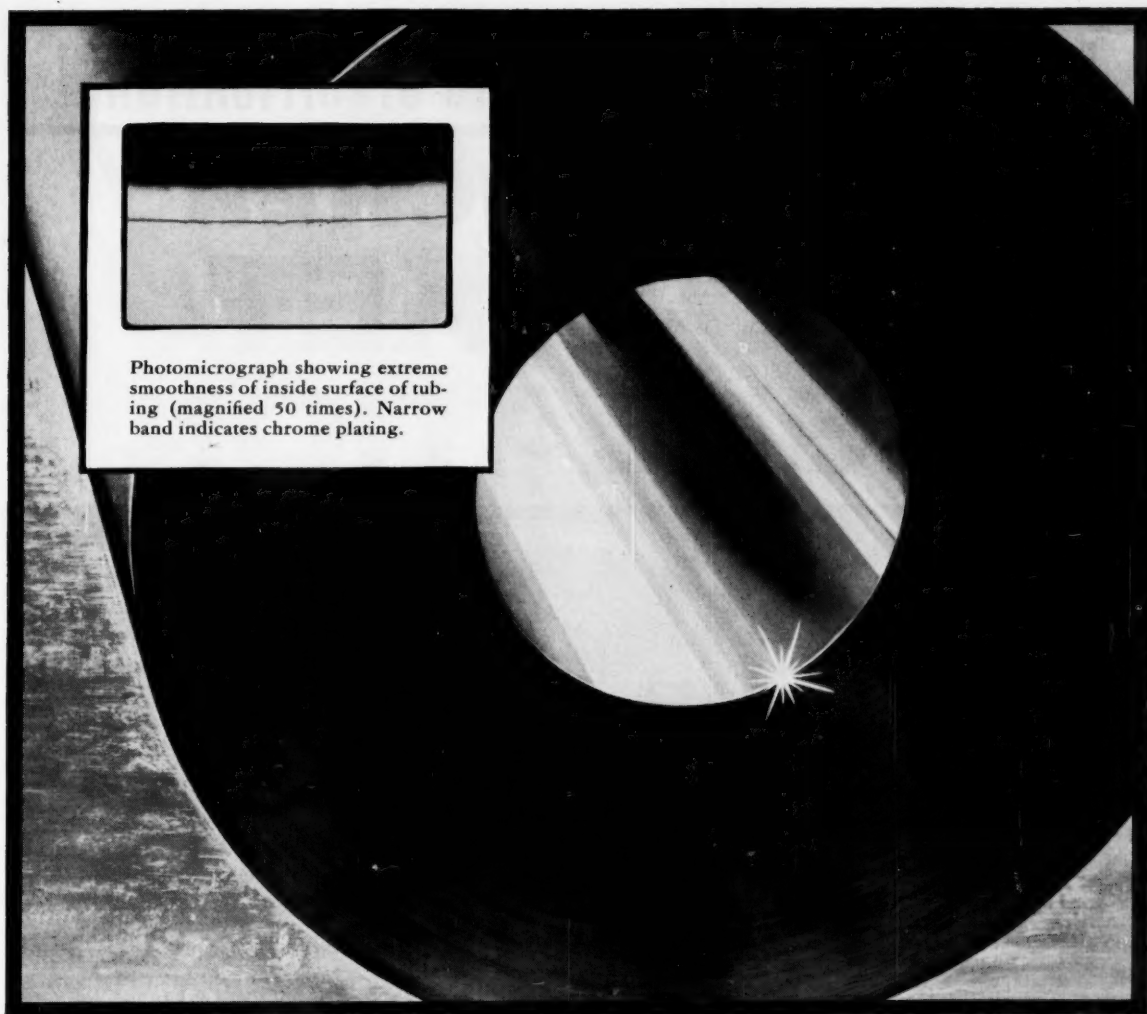
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LOS ANGELES  
Ryan  
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4 Lanesville Terrace, Forest Hills, Boston 31, Mass.

FIRST IN PURE WATER SINCE 1878





Photomicrograph showing extreme smoothness of inside surface of tubing (magnified 50 times). Narrow band indicates chrome plating.

## How to beat fatigue *caused by pulsating pressures up to 50,000 psi*

**PROBLEM:** Manufacturers of polyethylene plastic were plagued by *costly* fatigue failures in the heavy wall, high pressure steel tubing they were using. **Result:** Costly, frequent replacements with attendant production and time losses.

**CAUSE:** The tubing's inside surface had slight, almost invisible imperfections which gave the pulsating

pressures—varying between 35,000 and 50,000 psi—a toe hold for failures to start.

**SOLUTION:** Timken Company metallurgists recommended a specific low-alloy steel tubing that could be produced with a glossy-smooth interior surface. They used specially developed Timken Company processing techniques, based on

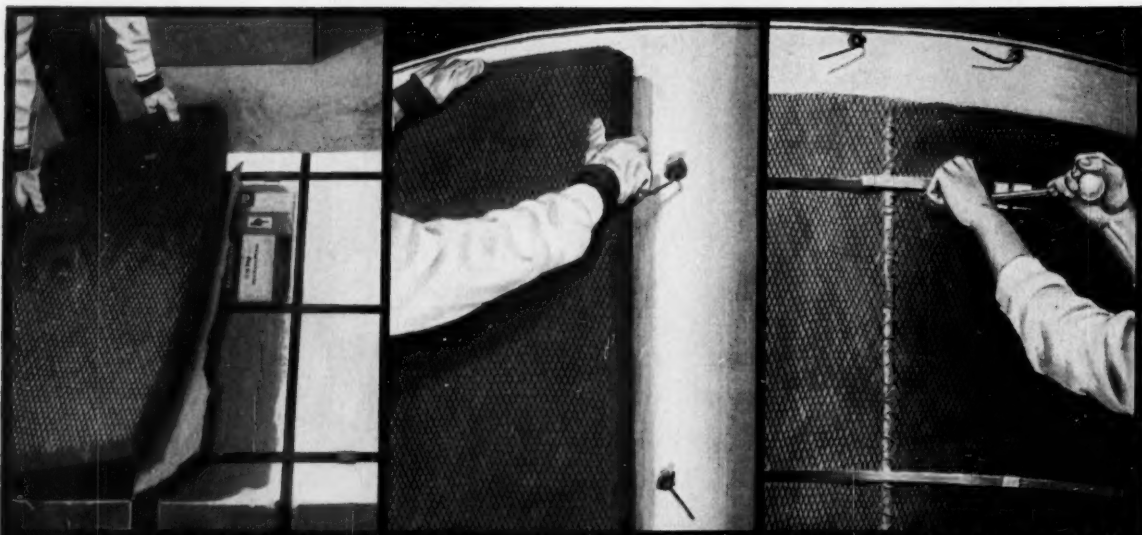
more than 40 years of experience with all types of high pressure steel applications. Result—another special steel problem solved.

**WHATEVER** your special steel problem, it will pay you to use the experience of the experts—metallurgists of the Timken Company. Give us a call the next time you need help. The Timken Roller Bearing Company, Steel & Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO". *Makers of Tapered Roller Bearings, Fine Alloy Steels and Removable Rock Bits.*

# TIMKEN<sup>®</sup> *Fine Alloy* STEEL

**FACTORY FABRICATED TO RIGID SPECIFICATIONS!**

# **EAGLE-PICHER BLANKET INSULATION**



*Ready for installation!*

*Easily conforms to surfaces!*

*Finished job, free of large voids!*

- Copper bearing steel laths, bound by uniformly spaced soft-drawn galvanized tie wires, keep blankets firm but flexible.
- Eagle-Picher mineral wool evenly dispersed over entire insulating area of each blanket.
- Completely free of large voids usually found in field-made blankets where insulation is simply packed in place.
- Smooth edges butted tightly together eliminate cracks and loose joints.
- Quickly applied to flat or slightly curved surfaces of any large equipment—or cut to fit irregular areas.
- Maximum thermal efficiency at temperatures as high as 1200 F.

*Eagle-Picher produces a complete line of industrial insulations for all temperatures from below Zero to over 2000 F.*

## **FREE SAMPLE!**

**Write today!**

Eagle-Picher Blanket Insulation conforms to Commercial Standard CS-117-49.

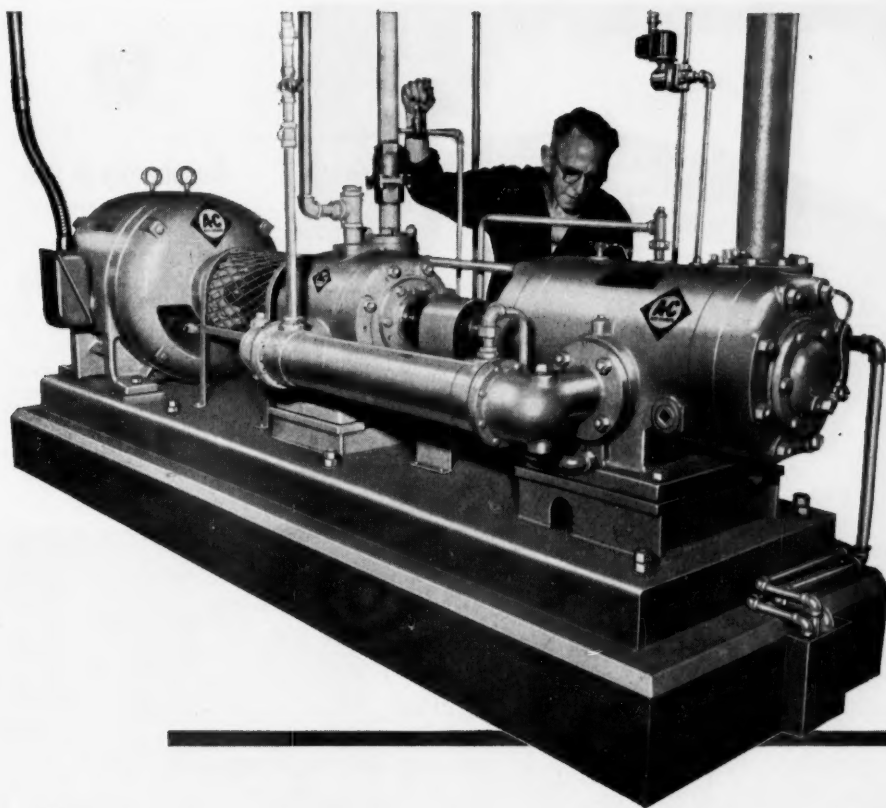


*Since 1843*

## **EAGLE-PICHER**

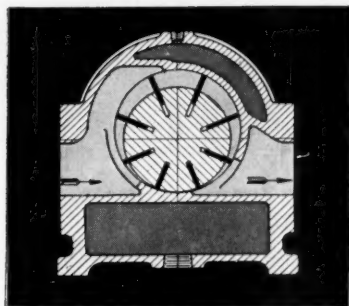
The Eagle-Picher Company • General Offices: Cincinnati 1, Ohio

*(Member of Industrial Mineral Fiber Institute)*

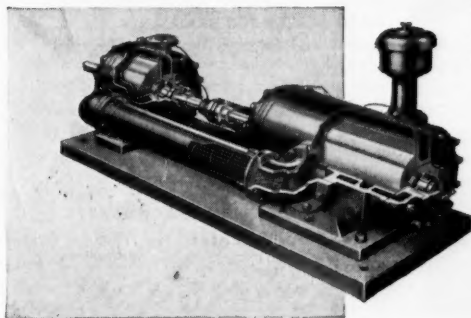


## Smooth operation—Prolonged efficiency

with **Ro-Flo** compressors for  
plant air supply



Simple operation—centrifugal force holds blades against sidewall to form air chamber.



Rotary operation is smooth, vibrationless. Compare this to the pounding and shock inherent in reciprocating compressors.

That's why *Ro-Flo* compressors eliminate the cost of heavy foundations. A slab is enough. Smaller units are bolted to the floor. And "like-new" efficiency is maintained for years — because rotor blades compensate for wear automatically.

No pistons, valves or connecting rods to cause trouble. Only two wearing parts in the *Ro-Flo* compressor. All this means far less maintenance.

Two-stage units range from 250 to 1800 cfm, from 60 to 125 lb gauge. Single-stage units from 40 to 3000 cfm, up to 50 lb gauge. Ask your A-C man for descriptive literature, or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin.

*Ro-Flo* is an Allis-Chalmers trademark.

**ALLIS-CHALMERS**



A-5899



## Respiratory & Eye Protection

### R5051 RESPIRATOR 701 GOGGLE

The respirator accommodates the goggle — and the goggle accommodates the respirator in the AO R-71551 — one of 44 respirator-goggle combinations available from AO.

Here's Quality Respiratory and Eye Protection...  
Singly or Together!

# R5051 / AO 701



#### Respirator ... B. of M. approved for organic vapors

This member of the American Optical family of R5000 Series Respirators uses our R51 Cartridge. Provides comfortable, dependable protection against low concentrations of light organic vapors and gases met with in paint spraying, degreasing, dry cleaning, cementing and similar operations. Adsorbs vapors of benzene, xylene, toluene, gasoline, naphtha, acetone, turpentine, etc. Permits excellent goggle clearance. Simple interchange of cartridges on basic face piece converts respirator economically for protection against other single or multiple respiratory hazards.



#### Rubber frame goggle. It's gas tight!

Recommended for work by maintenance men on acid lines, repairing and maintaining storage batteries, on metal plating, cleaning and degreasing, shakeout work in foundries — wherever gases, fumes and smoke endanger. NO VENTS IN FRAME, NO HOLES IN LENS FOR HEADBANDS. Lens is vinylite. Your nearest AO Safety Products Representative can supply you.

Always insist on  Trademarked Safety Products

American  Optical  
COMPANY  
SAFETY PRODUCTS DIVISION

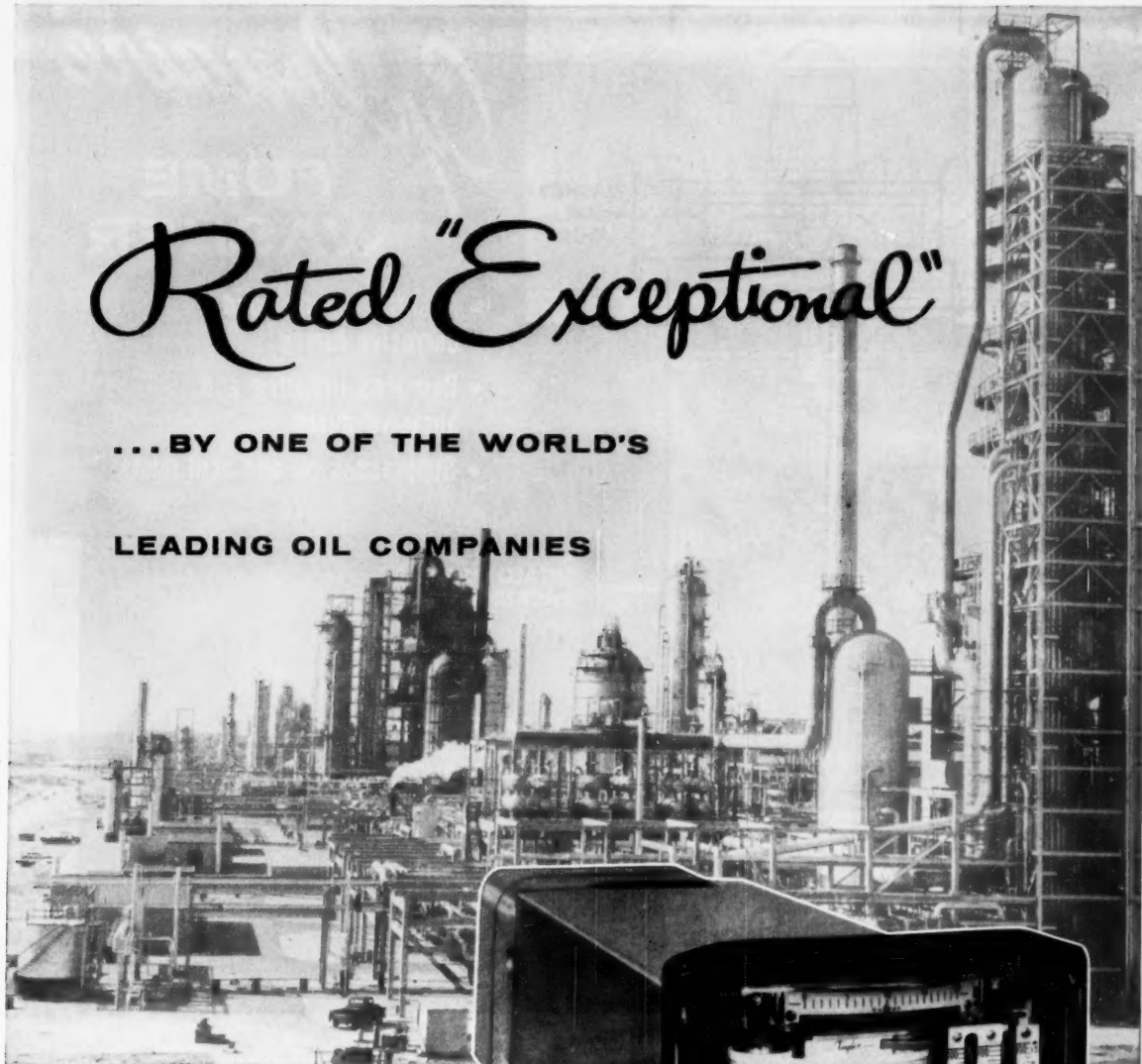
SOUTHBRIDGE, MASSACHUSETTS  
Safety Service Centers in Principal Cities



# Rated "Exceptional"

...BY ONE OF THE WORLD'S

LEADING OIL COMPANIES



An internationally famous oil company recently carried out exhaustive tests on the Taylor 90J TRANSCOPE® Recorder. This particular company is continually testing and evaluating instruments from all over the world.

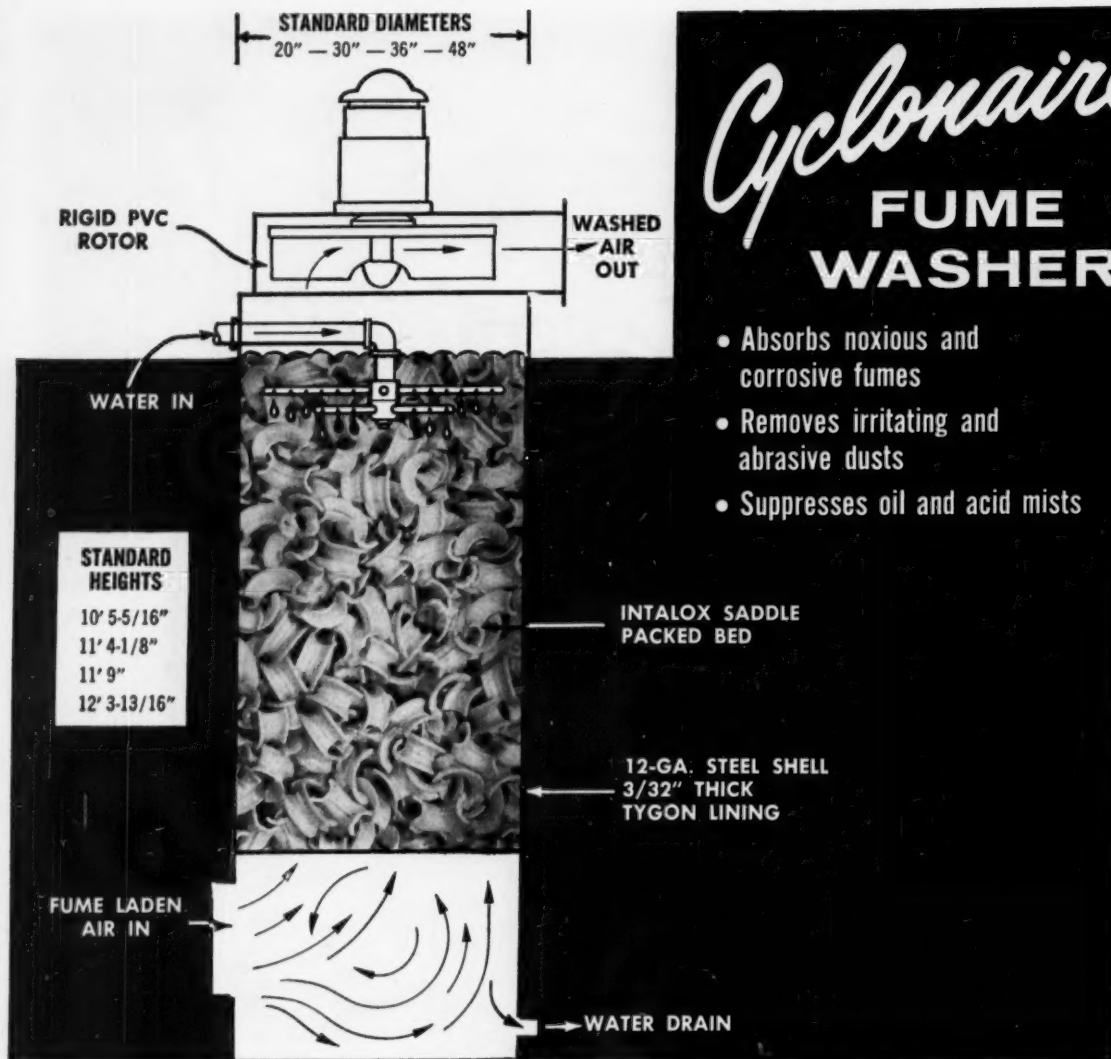
In the opinion of the qualified specialists of this world-famous company, the performance of the 90J Recorder was outstanding. In fact they were so impressed that they established a *new classification* . . . they rated it "exceptional".

Experience with this instrument has inspired the statement, "No other recorder puts so many features in so little panel space". And it's so easy to prove—make arrangements with your Taylor Field Engineer—to put a 90J TRANSCOPE Recorder on test. Taylor Instrument Companies, Rochester, N. Y., and Toronto, Ontario.

\*Reg. U.S. Pat. Off.

Look to Taylor for VISION . . . INGENUITY . . . DEPENDABILITY

## *Taylor Instruments* MEAN ACCURACY FIRST



# Cyclonaire

## FUME WASHER

- Absorbs noxious and corrosive fumes
- Removes irritating and abrasive dusts
- Suppresses oil and acid mists

The "Cyclonaire" is a surprisingly compact wet bed scrubber. It will fit almost anywhere, but it does a fume removal job formerly possible only with expensive custom-designed units. Removal of many gases (of 1% concentration or less) is up to 99% effective. Low power requirements make it very economical to operate.

The standard "Cyclonaire" consists of a bottom section containing a packing support plate, fume intake duct, and liquid drain; two intermediate sections packed with Intalox Saddle Packing; a distributor section containing a water or liquid inlet and liquid distributor; and

a top section containing the blower, drive motor and washed air outlet.

The unit is made of 12 gauge steel, lined with 3/32" thick Tygon sheet plastic. The rotor is made of rigid PVC plastic. All exterior surfaces are protected with Tygon "ATD" Hot Spray Paint.

The "Cyclonaire" is available in four sizes with rated capacities of 750, 1650, 3500 and 6000 cfm.

Its low initial cost, its low operating cost, its high efficiency make the "Cyclonaire" a logical choice for a wide range of fume scrubbing operations. Full technical data in Bulletin FW-10. Write for it today.



PROCESS EQUIPMENT DIVISION

**U. S. STONEWARE**

AKRON 9, OHIO

376F

DEVELOPMENTS ...

MARCH 9, 1959

# Chementator

C. H. CHILTON

**Foamed silicon carbide is newest high-temperature material available to reactor and furnace designers. Carborundum Co. expects this product to find higher-temperature applications than those served by Pittsburgh Corning's foamed silica.**

**Spencer Chemical has just put into operation at Pittsburg, Kan., a new plant for making uranium oxide nuclear reactor fuel. Capacity is rated at 50 tons/yr.**

**Welding thin sheets of high-melting metals is easier with Stauffer-Temescal's new electron-beam welding machine soon to be made commercially available. Using same basic principle is the electron-beam furnace for refining special metals. First commercial furnace will be used by Wah Chang at Albany, Ore.**

## Polypropylene broadens its base

Four more companies have joined the polypropylene race. In the past few weeks:

- AviSun Corp., progeny of American Viscose and Sun Oil, was incorporated and announced plans for early production of up to 20 million lb./yr. of polypropylene from leased facilities of Koppers' Port Reading, N. J., linear polyethylene plant.

- Shell Chemical Co. Ltd. disclosed plans for a 30,000-ton/yr. plant at Carrington, England, which will turn out both polyethylene and polypropylene.

- Montecatini made public the signing of license agreements with two French firms—Pechiney and Societe Normande de Matieres Plastiques—who will each build plants to make 22 million lb./yr. of polypropylene.

These developments follow closely on Montecatini's recently announced plans to produce polypropylene in Austria by the newly formed Danubia Petrochemie AG. And negotiations are currently in progress for licensing agreements in other countries.

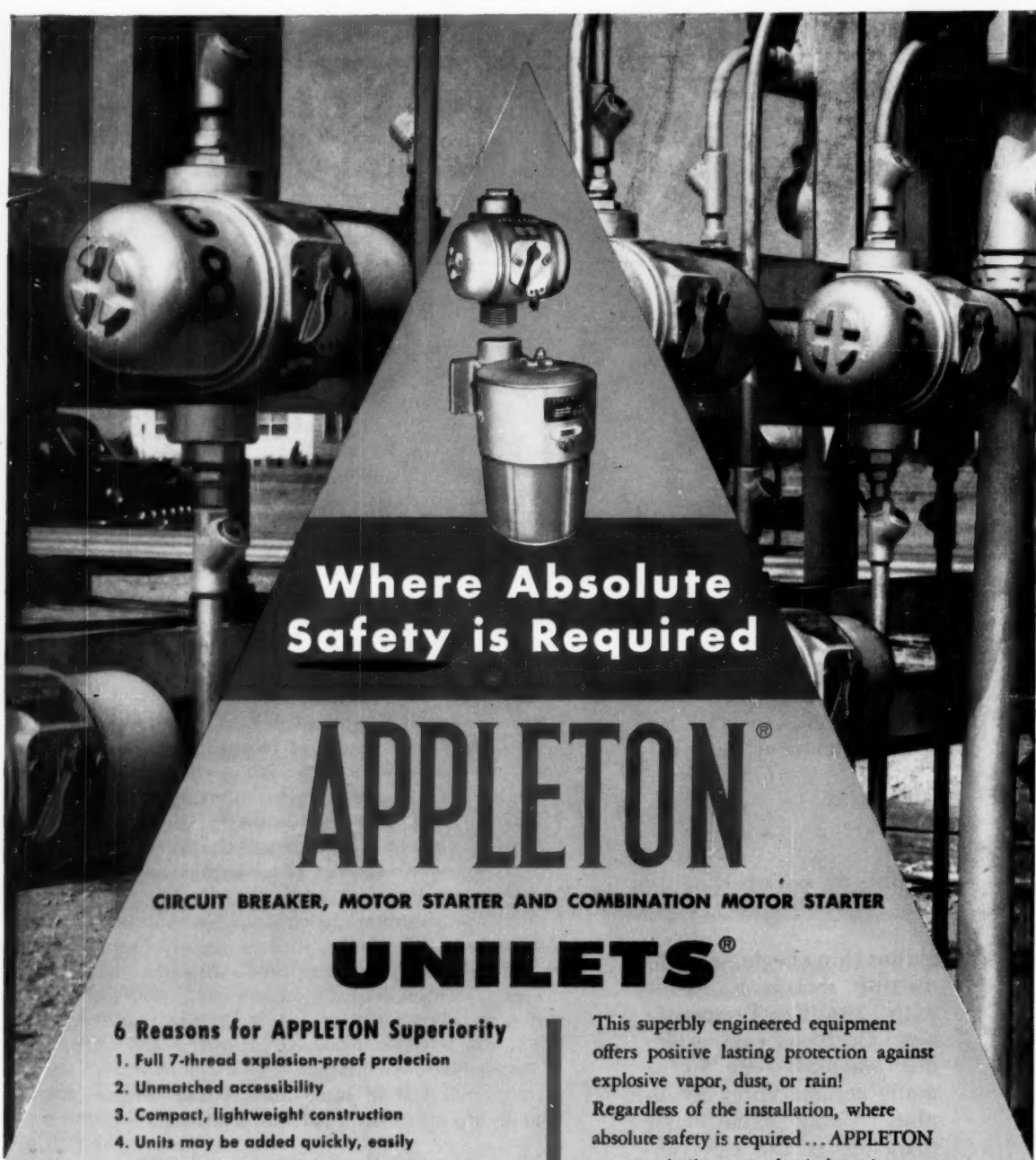
These negotiations probably include final dickering with Shell. Shell is already exclusive licensee in the United Kingdom for Ziegler's high-density polyethylene process. But re polypropylene, Shell says only that it will use a Shell-developed process based on Ziegler-Natta techniques. This would imply that Shell will in some manner pay tribute to Montecatini-Natta patents in Britain.

## Norway leads with heavy-water reactor

First commercial-size heavy-water-modulated, natural-uranium-fueled nuclear power reactor has come into operation.

Located at Halden, Norway, the \$3.7-million boiling-water installation began stabilization runs late last year. Rated thermal output is 10,000 kw. Plans call for upping this to 20,000 kw., switching over to slightly enriched uranium fuel at a later date.

Reactor is under the Auspices of JENER, a joint Norway-Netherlands government



**Where Absolute  
Safety is Required**

**APPLETON®**

**CIRCUIT BREAKER, MOTOR STARTER AND COMBINATION MOTOR STARTER**

**UNILETS®**

**6 Reasons for APPLETON Superiority**

1. Full 7-thread explosion-proof protection
2. Unmatched accessibility
3. Compact, lightweight construction
4. Units may be added quickly, easily
5. Flexible field set-ups with single and duplex male and female hub adapters
6. Combinations meet U. L. requirements through approval of components

This superbly engineered equipment offers positive lasting protection against explosive vapor, dust, or rain! Regardless of the installation, where absolute safety is required... APPLETON... your single source for industry's most complete line of explosion-proof equipment... can serve you better!

*Sold Through Franchised Distributors Only*

Also  
Manufacturers  
of:



Explosion-Proof Fixtures



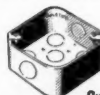
"ST" Series Connectors



Automatic  
Reclosers



Industrial  
Lights



Outlet Boxes



Rely on  
**APPLETON...**  
the Standard for  
Better Wiring®

**APPLETON ELECTRIC COMPANY • 1709 Wellington Avenue • Chicago 13, Illinois**



agency. Classed as an experimental project, reactor produces no electrical power. Thermal output is converted via a heat exchanger to process (light-water) steam and consumed by a nearby paper mill.

Why use costly heavy water in a power reactor? It's a question of relative cost and availability of heavy water vs. enriched uranium. A nuclear reactor will work on natural or slightly enriched uranium fuel only if heavy water is used as moderator. Use of light water, or some other moderator, requires a higher proportion of U-235.

To date, nuclear development in the U. S. has capitalized on the ready availability of U-235 in this country. In such countries as Canada and Norway, however, heavy water is much easier to come by than U-235, accounting for their different approach to commercial nuclear power.

### Here's a new partial oxidation process

Among recent process imports is the Shell gasification process for converting fuel oil into CO-H<sub>2</sub> synthesis gas via partial oxidation. Procon is now licensed to sell the process in the U. S. So far there have been no takers.

Developed originally by Shell's Dutch parent, process is used by five plants abroad to make gas from oil. These include a Shell ammonia plant and a \$9-million manufactured gas plant, both in England. Process can also utilize gaseous hydrocarbons.

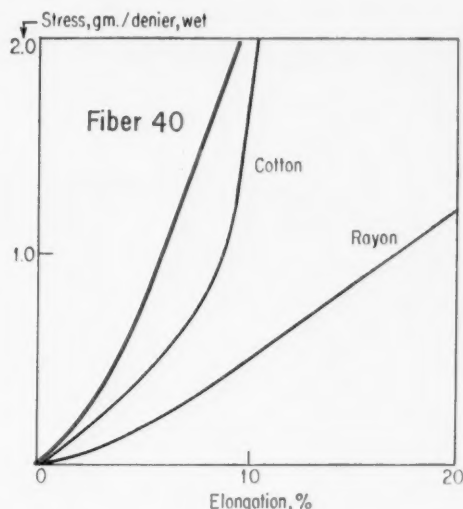
Shell's process is competing with the well-entrenched Texaco partial oxidation technique, used in 35 plants throughout the world (operating or under construction). First on stream commercially was at Spencer's Vicksburg, Miss., ammonia plant.

But of the 11 Texaco gasification plants in the U. S., only two use fuel oil: Northern Chemical Industries, Searsport, Maine, and a classified government plant near Cape Canaveral. Ready supplies of natural gas in the southern and western parts of this country preclude wider use of fuel oil by ammonia-methanol producers. However, they can convert to oil with little difficulty if needs be, says Texaco.

The two processes are similar technically, using oxygen to partially oxidize hydrocarbons in a special burner. Pressures range from 75 to 500 psi. and temperatures from 2,000 to 2,700 F., depending on feedstock. In fact, processes are so alike that some patents

overlap. Since Texaco has priority, Shell pays royalties to Texaco for every plant Shell licenses.

Shell offers customers a single package, guaranteeing CO-H<sub>2</sub> content of the final gas. Texaco, on the other hand, licenses several engineering companies, each with its own schemes for processing gas from the burners.



### New fibers pose threat to cotton

Man-made fibers, having conquered silk and put wool on the run, are now unloosening a frontal attack on King Cotton itself.

Three new cellulosic fibers were unveiled simultaneously last month by three leading rayon producers. Their properties have been tailored specifically to make them more competitive with cotton than any man-made fibers previously available. Here's the lineup:

- American Enka has developed a product designated as Enka Fiber 500. This fiber, says Enka, permits production of fabrics in which shrinkage can be effectively controlled, as in cotton, by Sanforizing.

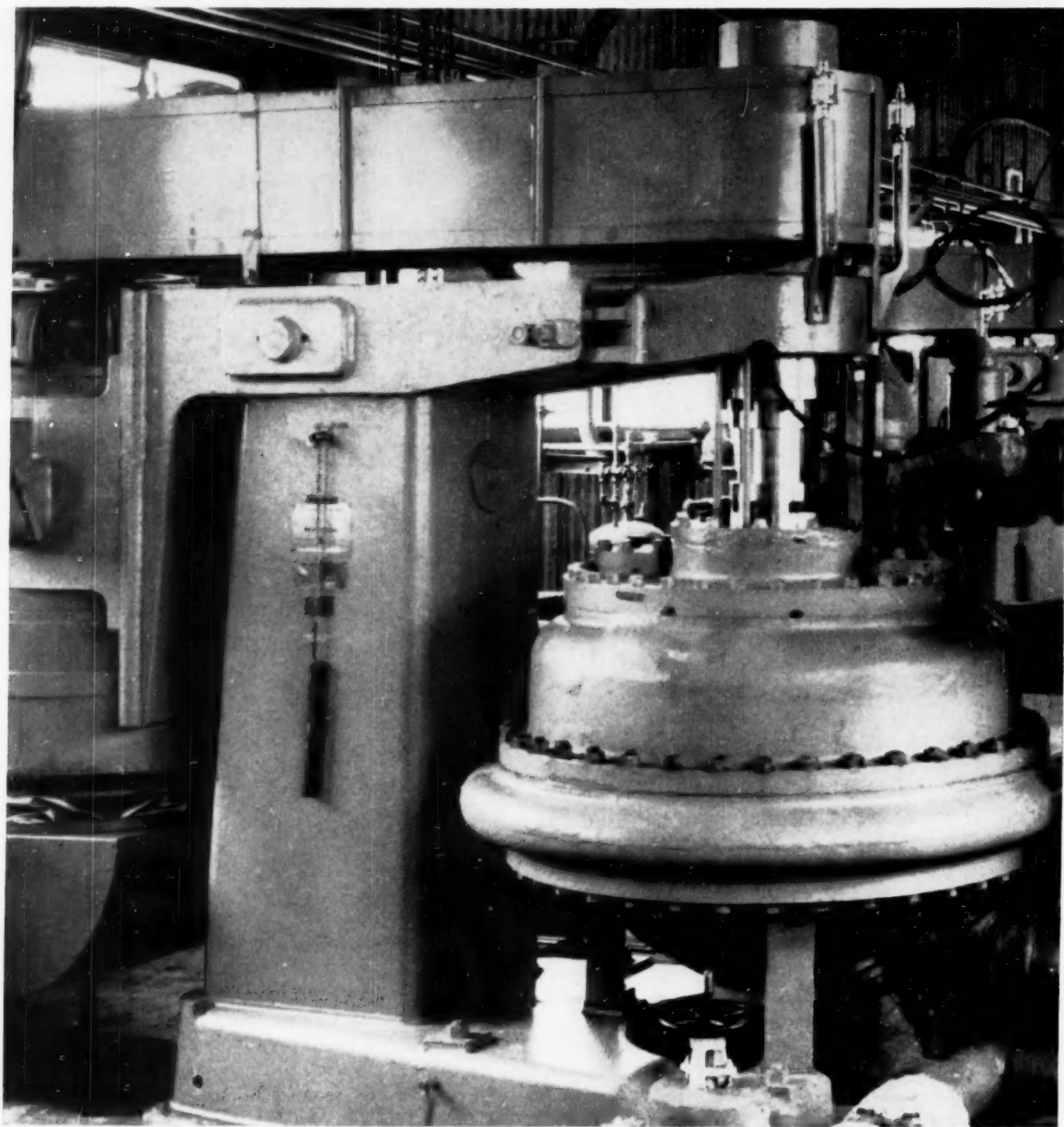
- American Viscose also claims easy Sanforizing for its new Fiber 40. High wet modulus is said to make it "an ideal blending fiber for use with cotton as well as the hydrophobic fibers."

- Courtaulds' entry is tagged SM-27. Its properties are similar to the others.

All three products are of the same chemical family as rayon—regenerated cellulose—

(Continued on page 72)

# MORE PRODUCTION OF HIGH



## MERCO PRESSURE CENTRIFUGES

*operate 24 hours a day . . . 7 days a week . . . at W. R. Grace's Polymer Chemicals Division*

Large-scale production is provided in the plant of the W. R. Grace Polymer Chemicals Division to answer the growing demand for high-density linear polyethylene. The product is marketed under the trade name of GREX and is manufactured under license by the Phillips process.

For the catalyst removal step, Merco Pressure

Centrifuges insure high quality product and continuous operation. The polyethylene polymer solution containing catalyst is fed through Merco Rotary Strainers to Merco Pressure Centrifuges which operate 24 hours daily, 7 days a week at superatmospheric pressures and temperatures. Each centrifuge can deliver an effluent product of *less than 8 ppm*

# DENSITY POLYETHYLENE!



impurity. Two-staging of the polymer-catalyst separation results in very high polymer recovery.

Merco Continuous Pressure Centrifuges and Strainers are the *only* units of their type continuously effecting a polyethylene-solid catalyst separation. The Merco Pressure Centrifuge has

revolutionized many operations in the processing industries, where continuous efficient, high speed, controlled separation is required. Types are available to suit a wide variety of applications. For information, write Dorr-Oliver Incorporated, Stamford, Connecticut.



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Merco - TM Reg. U. S. Pat. Off.

and can be produced on rayon spinning machines. But, say the companies, they are different enough from rayon (and from each other) to make their way in commerce on their own names. These differences are ascribed to changes in the starting cellulose pulp and in spinning techniques.

One of rayon's chief drawbacks has been its tendency to "felt" when wet. This causes rayon to shrink. Fundamental investigation (which the three producers shared) revealed that this defect could be licked if a cellulosic fiber had a stress at 5% extension of not less than 0.5 gm./denier, i.e., a high wet modulus (*see chart, p. 69*).

Armed with these research findings, the three firms proceeded independently to develop their own tailor-made fibers. Officially, the three new products, when commercialized, will be competing with each other. Unofficial speculation is that the gratifying results to date from the industry's cooperative marketing of Tyrex rayon tire cord may well lead to a similar setup for promoting the new fibers.

### Get set for assault on natural rubber

D-day is approaching for the chemical engineer's big campaign to capture the final one-third of the U.S. rubber market still held by natural rubber.

Immediate objective—a limited but strategic one—is commercial production of polybutadiene rubber. Firestone expects to be first to reach this position with a 30,000-ton/yr. plant at Orange, Tex. Construction schedule hasn't been set, but company says engineering is well along. Product will be called Diene.

Most other firms with rubber interests are also aiming at this objective. Phillips, for example, will next week start up a new semicommercial plant capable of making one million lb./yr. of Cis-4, Phillips' trademark derived from the generic chemical name, cis-1, 4 polybutadiene. Introductory price tag for Cis-4: \$1/lb.

Polybutadiene is not expected to replace natural rubber directly. Rather, it will probably be blended in approximately equal quantities with natural rubber for use in heavy-duty tires now made completely of natural. Thus its net long-range effect would be to halve the proportion of the market now supplied by natural.

Complete displacement of natural can't

come until polyisoprene rubber is commercialized. Both Firestone and Phillips say their new facilities will be able to turn out polyisoprene as well as polybutadiene. But economic incentive is lacking. Present cost of high-purity isoprene monomer (now produced by Phillips from crude supplied by Enjay) is too high in relation to cost of natural rubber.

This situation is likely to improve. Isoprene can be made from isopentane or isopentene by the same Houdry dehydrogenation process now used to produce butadiene from butane. And C<sub>5</sub> feedstock will become increasingly available to oil refiners as the result of coming technological changes in manufacture of high-octane gasoline.

### Process adds to concrete's stature

A Dutch process for chemical treatment of concrete is catching on in Europe, has now spread to two other continents and, sooner or later, is bound to show up in the U. S.

Developed by Ocrietfabriek N. V. at Baarn, Netherlands, the process involves exposure of concrete products to silicon tetrafluoride vapor. Chemical reactions of the various minerals with SiF<sub>4</sub> alter the concrete so that its chemical resistance is markedly increased, along with improvements in wear resistance, compressive strength and impermeability.

Ocriet has put in three "ocratation" tunnels, each about 6 ft. dia. by 40 ft. long. Other ocratation installations are in Denmark, Germany and Australia. These will soon be joined by new units in France and Union of South Africa.

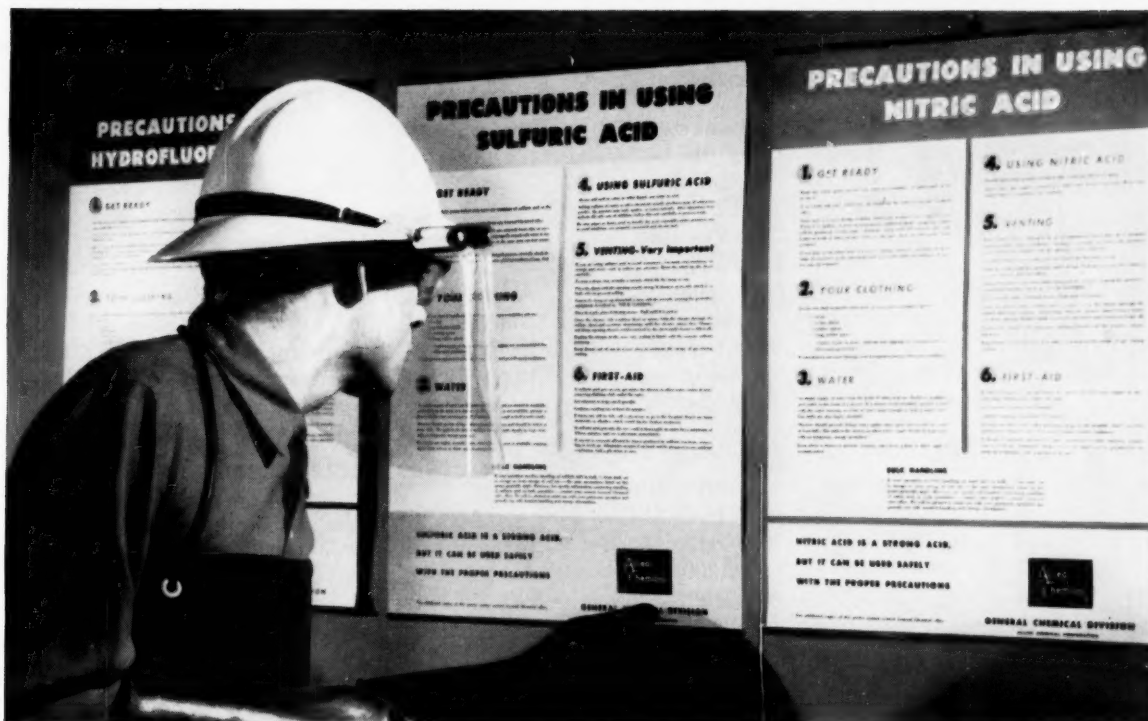
Biggest uses of ocratation so far have been on treatment of concrete pipe and floor tile. Ocriet hopes to eliminate the need for bituminous lining of concrete sewerage pipe.

Up to now, no U. S. firm has licensed Ocriet's know-how and patent rights (U. S. 2,657,154). Ocriet tells *CE* that ocrated concrete is being tried in Hooker and Dow chlorine cells. Hooker disclaims any knowledge of these tests but suggests that one of its cell licensees may be involved. Dow declines to comment.

Surface treatment of concrete is not new. Washing of uncured concrete with aqueous solutions of fluosilicates has been practiced in the past to some extent. However, the vapor-phase ocratation process is claimed to be better because of much deeper penetration of the chemical reactions.



**Now Available from General Chemical...**



## 3 New Safety Posters on the Proper Handling of Strong Acids

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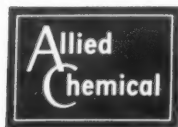
Here's essential information on how to handle sulfuric, hydrofluoric and nitric acids safely . . . from the people who know them best.

As the nation's leading producer of these strong acids, General Chemical now offers 3 safety posters which spell out the precautions that *must* be taken when handling sulfuric, hydrofluoric or nitric acid. The posters contain such important information as: the proper clothing to wear and the equipment to use; the use of water as a neutralizer; the importance of venting; first aid, and many other necessary precautions.

The posters are free. They are large and easy to read—17 inches wide by 22 inches long. They come

complete with metal rims, top and bottom, ready to post in a prominent position in your plant. To obtain any or all three, mail the coupon.

**Mail Coupon for Posters!**



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**GENERAL CHEMICAL DIVISION**  
**ALLIED CHEMICAL CORPORATION**  
40 Rector Street, New York 6, N. Y.

CE-39

Please send your free safety posters checked below.

- ☐ Precautions In Using Sulfuric Acid  
☐ Precautions In Using Hydrofluoric Acid  
☐ Precautions In Using Nitric Acid

Name \_\_\_\_\_

Title \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

## Epoxidation scores new gains

General Mills, a pioneer in research on epoxidized fatty esters for stabilizing vinyl resins, has finally jumped into this market with two products of its own.

Dubbed EpoxyGen-80 and EpoxyGen-90, these epoxidized soybean oils are claimed to outrank in quality other chemically similar products now on the market. They have higher epoxy contents, fewer impurities, lower viscosities and lighter color, says GM, yet will sell in the same price range (33-35¢/lb.).

Two factors have previously discouraged GM's entry into this field. The vinyl resin stabilizer market was too small, and GM didn't have a product it was proud of. Market growth (it's now estimated at 20-25 million lb./yr.) eliminated the first factor; development of the new EpoxyGens took care of the second. Products have already been made commercially in facilities at Minneapolis; new facilities are due on stream next year.

General Mills acclaims the high epoxy contents of EpoxyGens. At 85-90%, they exceed existing products by as much as 10%. Though quiet about manufacturing details, GM gives credit to these improvements over conventional processes: Use of a specially prepared soybean oil base; a new and different catalyst; major improvements in purification steps.

The basic epoxidation process (*Chem. Eng.*, Aug. 1953, pp. 118-122) involves the catalytic reaction of an unsaturated vegetable oil or fatty acid ester with peracetic (or performic) acid. The per acid is made *in situ* by reaction of acetic (formic) acid with hydrogen peroxide. In early process versions, the catalyst was commonly sulfuric acid. Later on, acid-like cation exchange resins were found advantageous.



## Tomorrow's Technology

Today's embryonic developments which have special significance for chemical engineers

### Zone melting produces pure organics

Outstanding success of zone refining for making transistor-grade silicon and germanium has spawned embryonic applications of this technique to production of high-purity chemicals.

Based on results of a survey by *CE*, greatest progress in this field seems to have been made by a British firm, L. Light & Co., Colnbrook, England. This company is purifying polyphenyls (e.g., anthracene, stilbene and terphenyl) in batches of 1 to 5 lb. Purified product is used to grow single crystals which are made into scintillators.

Light has also developed a technique for purifying liquids by first freezing them, then zone-melting the frozen solid. This method has been used to remove water and other impurities from dioxane (m.p., 50 F.), producing a spectroscopic-grade solvent.

### Shock tube freezes chemical reactions

A research technique heretofore applied principally by aeronautical engineers to study fluid dynamics is now being put to work on chemical research by Shell Development chemical engineers at Emeryville, Calif.

The tool—an 18-ft. length of 6-in. steel pipe known as a "shock tube." The objective—to study rapid chemical reactions under extremes of temperature and pressure. The shock-tube technique achieves the desired reaction conditions in microseconds, then cools and depressurizes the reaction products just as rapidly to "freeze" the various chemical equilibria.

Source of energy is helium held under pressure in a portion of the tube. This section is separated from the reaction section by an aluminum disk. At the other end of the pressure chamber is another disk which separates it from a 3-ft.-dia. evacuated cylinder.

To run a typical experiment, the helium is first pressurized to a predetermined level. Then an electric discharge splits the first disk, and supersonic expansion of gas into the reaction chamber creates a shock wave, instantly raising the temperature and pressure of the chemical reactants therein. A split second later, the other disk is similarly parted, permitting the vacuum chamber to suck back the helium and depressurize the reaction.

Work of a similar nature has recently been reported by researchers at Cornell Aeronautical Center (Buffalo) and at Brown University. The former was sponsored by Monsanto, the latter by the Air Force. Both studies dealt with pyrolysis of light hydrocarbons.

For more on DEVELOPMENTS . . . . . 76



## Cleveland Speed Variators help maintain high quality of Philprene Polymers

At Phillips Chemical Company, Borger, Texas, engineers report "Degree of agitation is a most important variable in the coagulation of synthetic rubber latices."

Phillips Chemical uses 17 Cleveland Speed Variators in their Copolymer plant to provide the necessary process flexibility when changing from one type of their Philprene synthetic rubber to another.

These rugged Variators permit close control of coagulation tank agitation at the optimum level for each type of rubber produced, and help maintain the high quality of all their Philprene polymers.

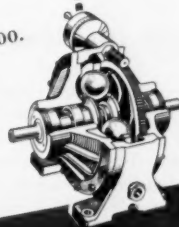
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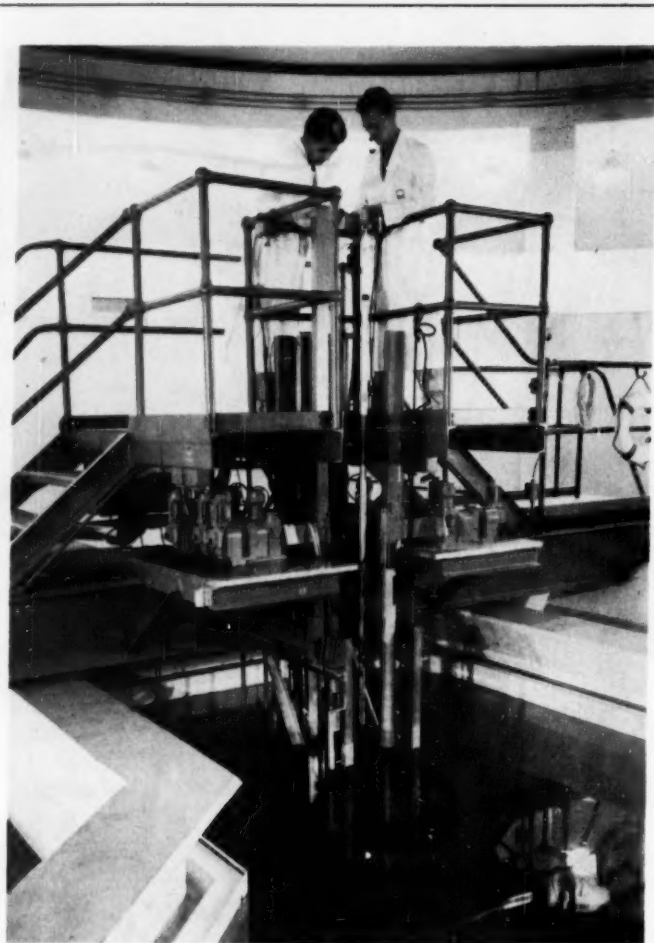
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### HOW IT WORKS

Power is transmitted from input shaft to output shaft through alloy steel driving balls which are in pressure contact with discs attached to the two shafts. Relative speeds of the position- ing of the axles on which the balls rotate (see cutaway view, right).



**CLEVELAND**  
**SPEED VARIATOR**



### Industrial Research Reactor Now in Operation

Now busily at work providing a source of neutrons, gamma rays and radioactive isotopes, new privately owned "swimming-pool" reactor will be used for basic and applied studies in many fields. The 5,000-kw. reactor is owned and operated by Industrial Reactor Laboratories.\* Reactor core is immersed in 136,000 gal. of demineralized water, 27 ft. below the pool's surface. Twin heat-exchanger units consist of 2,200-gal./min. primary circuit (116 F. down to

100 F.) and secondary cooling circuit (87 F. to 102 F.). Experiments are carried out at the base of the reactor through ports which open into tubes extending through the water to within various specified distances from the radioactive fuel source. Fuel is 10 lb. of enriched uranium.

\* IRL is owned by the following companies: American Machine & Foundry (which designed reactor), American Tobacco Co., Atlas Powder Co., Continental Can, Corning Glass Works, National Distillers & Chemical Corp., National Lead Co., Radio Corp. of America, Socony Mobil, U. S. Rubber.

### Ceramic Sponges Store Radioactive Wastes

Plans are under way for a full-scale investigation of ceramic sponges for disposal of liquid radioactive wastes. Mixtures of clay show considerable promise for this purpose, according to C. W. Christenson, group leader of the health division of University of California's Los Alamos, N. M., laboratories.

Process involves preparation of highly porous clay bodies or sponges which have been fired to about 1,440 F. The sponge is soaked in the liquid waste, dried and re-soaked; the cycle can be repeated as many as three or four times. The sponge is finally fired at about 2,370 F. to bond the radionuclides permanently.

In experiments, according to Christenson, sponges have absorbed radioactive waste up to 200% of their own weight after four cycles. Additional cycles increase this weight, but at a diminishing rate.

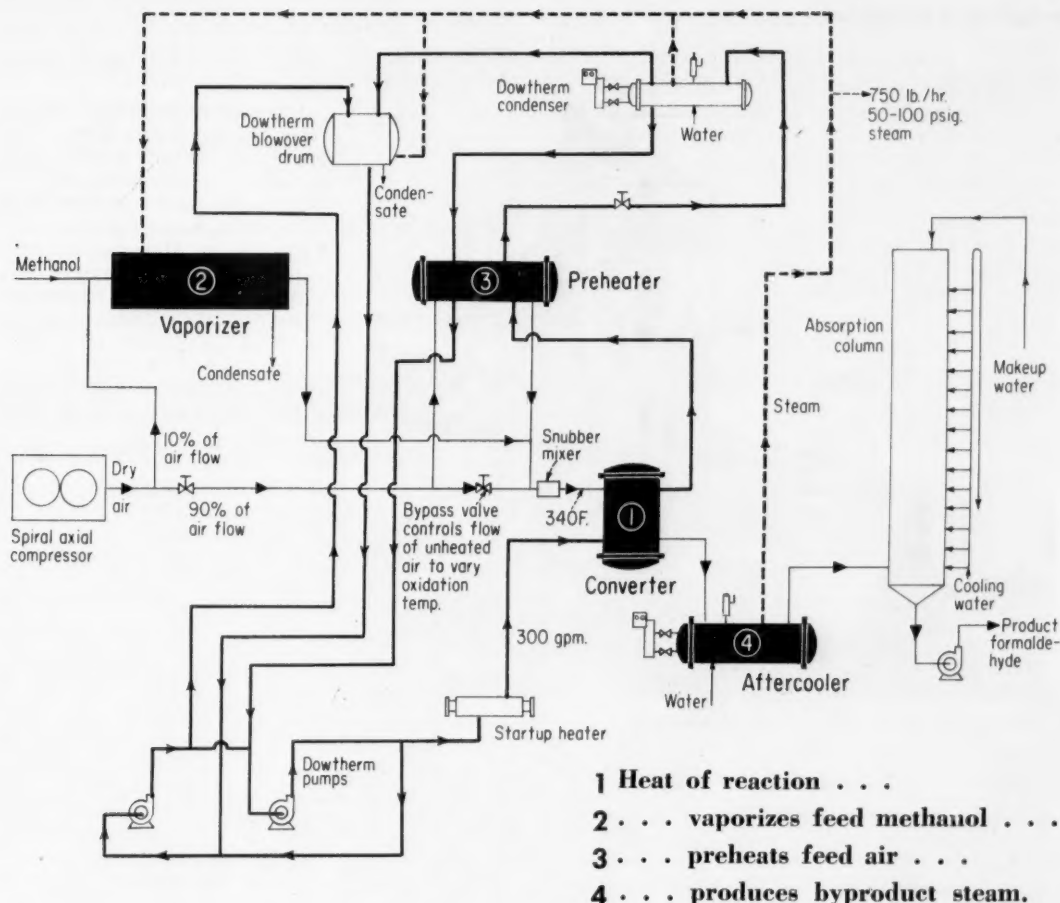
► **Ceramics Useful**—Early work on the technique was done with ceramic sponges prepared by Coors Porcelain Co., Golden, Colo., which suggested the idea.

Clay sponges are made using gas bubble foaming agents and highly absorptive materials such as calcined clays and diatomaceous earth. Naphthalene, wood, cork or other organics can be used as burnout materials to fire the sponge's interior.

In a few tests, simulated wastes were spiked with strontium 90 and cesium 137, absorbed in ceramic sponges and fired to 2,370 F. Subsequent leaching with water showed essentially no radioactivity in the leach.

Though cost estimates can't be made yet, Christenson guesses that costs probably won't exceed those of liquid storage of wastes. One advantage, Christenson points out, is that radioactivity in the wastes can be of value. Clay sponges contain radiation in useful physical form as sources of gamma and beta rays.





## Redesign Improves Use of Reaction Heat

Drawing on the operating experience logged at its Seattle, Wash., formaldehyde plant, Reichhold Chemicals' process designers worked several improvements into the firm's new Tacoma, Wash., HCHO unit. Main benefit reaped from the design changes has been the transformation of the process from a steam consumer into a steam exporter. As a bonus, process control has been improved.

The Tacoma and Seattle formaldehyde units use an original Reichhold process, first commercialized in the 35-million-lb./yr. plant at Seattle (*Chem. Eng.*, Nov. 1954, pp. 109-110). New Tacoma unit, which came on stream about a year ago, is rated at 25 million lb./yr. and cost \$250,000.

RCI's process—based on the standard catalytic oxidation of methanol with air—employs a special catalyst, described only as "a mixture of metallic oxides." Over-all process yields are greater than 90%. Many older formaldehyde processes using silver catalysts require multiple converters, getting percentage yields in the 80's.

However, RCI's newest formaldehyde plant (its 14th) at Hampton, S. C., employs a silver-catalyst process that boasts about the same economics as the oxide-catalyst process. RCI's East Coast engineers have more experience with the silver process which is why it was picked for the Hampton plant.

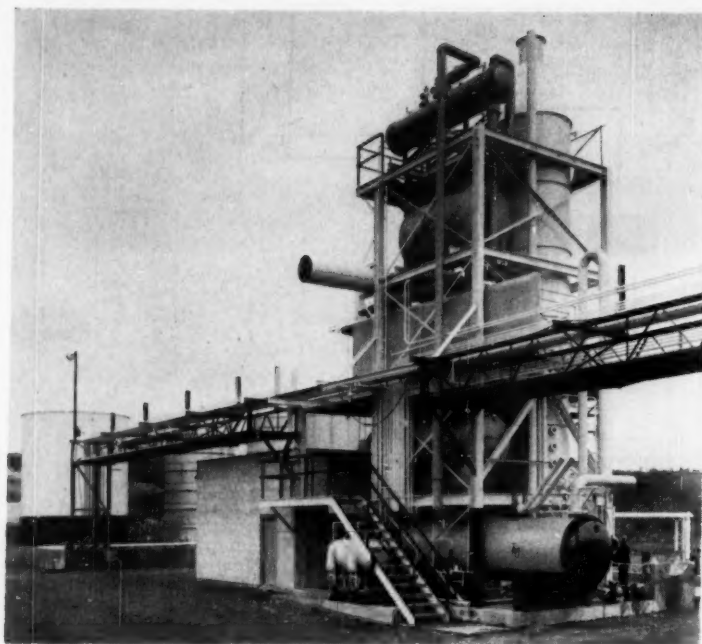
► **Exporting Steam**—All formaldehyde processes generate heat

through the exothermic reaction:



With RCI's metallic oxide catalyst, this oxidation reaction proceeds at about 700 F. Through improved mechanical design, the Tacoma unit now generates 750 lb./hr. of 50-100 psig. steam—most of which goes to the adjacent pentachlorophenol plant. Seattle plant, by contrast, consumes 0.8 lb. steam per pound of product (at \$1.40 per 1,000 lb.). Power and water consumption per pound of formaldehyde is slightly higher at Tacoma: 0.11 kwh. and 67 lb. compared to 0.08 kwh. and 56 lb. at Seattle.

Tacoma's water consumption is higher because the plant does



IMPROVED design makes Reichhold's Tacoma formaldehyde plant compact.

not have a cooling tower for water recycle as there is at the Seattle plant. But steam savings more than offset the small increases in the other utilities.

► **Changes Bring Dollars**—A relatively simple change—the replacement of a compressor—greatly improved the heat balance of the plant.

RCI installed a spiral axial compressor to supply dry air to the new unit. Older Seattle plant uses water-sealed blowers which consume water at 70-80 gpm. This added vapor in air stream increases heat load on the vaporizer and reduces heat recovery efficiency.

Air compressor and Dowtherm pump in the heat recovery system are electrically interlocked so that pump will not operate if the compressor fails to go on. Automatic shut-off of the methanol feed provides additional safety in case of a breakdown elsewhere in the system.

► **Bypass Air**—In the original process design, air and liquid methanol were fed together to a steam-jacketed vaporizer. But the Tacoma plant gets by with a much smaller S-tube vaporizer

which uses only a small portion of the main air stream.

Feed ratio is 5-11 moles methanol per 100 moles of air. Only 10% of the air stream flows through the methanol vaporizer primarily to suppress surging caused by flashing of the methanol.

Main air stream flows to a Dowtherm-heated preheater which did not appear on the original flowsheet. A wide range of air preheating is possible through bypassing some of the air around the preheater—giving an added degree of control over the oxidation temperature. Air-methanol stream from the vaporizer joins the main air stream at the outlet of the preheater at 300-350 F. and feeds to the catalytic converter.

► **Conserving Btu.'s**—Most of the reaction heat is recovered by circulating Dowtherm.

Dowtherm is pumped at 300 gpm. into the converter shell: This high circulation rate maximizes heat transfer and allows close temperature control. Boiling Dowtherm passes to the air preheater which also is a vapor-liquid separator. Vapor then flows to a shell-and-tube con-

denser which acts as a waste-heat boiler.

Remaining Dowtherm vapor from the condenser flows to a knockout drum which also doubles as a storage tank. The tank is rigged for gravity flow in event of pump failure.

► **Change in Materials**—Formaldehyde storage tanks in the Tacoma plant are fabricated from Type 304 stainless steel instead of resin-lined mild steel as at Seattle. RCI finds that stainless costs about the same installed and eliminates all need for relining.

All process piping and equipment is mild steel except the stainless steel column.

► **Reactor Design**—Reactor at Tacoma is identical to the original one at Seattle. It consists of about 2,000 tubes, 1 in. dia. and 4 ft. long, in a mild steel shell.

Tubes are loaded with 30 in. of oxide catalyst and covered with a screen in the steel grid cover. Screen and grid prevent an aspirator effect which would be produced by the high-velocity air-methanol stream entering the converter perpendicular to the tops of the tubes. Grid also creates additional turbulence which minimizes pressure build-up on the converter wall opposite the inlet.

► **Process Briefing**—Air-methanol mixture entering the top of the converter is preheated by boiling Dowtherm in the converter shell. Heated to 500 F. by the time it hits the catalyst, gas temperature rises to 600-715 F. at the center of the catalyst bed. Reacted gas cools against boiling Dowtherm as it leaves the catalyst tubes.

Gases from converter pass through a waste-heat boiler, generating process steam. Gases cool to a temperature just below the dew point of formic acid (present in fractional percentages as an undesirable side-product) and pass to the stainless-steel bubble-cap absorption column. Water flows counter-currently to the gas stream, maintaining a 40% formaldehyde solution (by weight) at the tower bottom. Ion exchange removes traces of formic acid and ferric hydroxide from the product.

## Served 6 years on a "6-month job"

Even special alloy pipe lasted a scant six months on this job: carrying highly abrasive phosphate slurry at a Florida refinery. That meant recurring shut-downs—costly replacement.

But the G.T.M.—Goodyear Technical Man—had another idea: Pipe protected with specially compounded PLIOWELD. This super-tough lining defies the destructive action of a wide range of abrasives and corrosives.

In fact, at last report, the pipe lined with PLIOWELD had already put in 6 years of service—12 times as long

as its predecessor—with no breakdowns—no replacements. And it looked good for years' more service.

A moneysaving solution like this to your problem? Whenever industrial rubber goods are in question, call for the G.T.M. by contacting your Goodyear Distributor—or by writing Goodyear, Industrial Products Division, Akron 16, Ohio.

**IT'S SMART TO DO BUSINESS** with your Goodyear Distributor. He can give you fast, dependable service on Hose, V-Belts, Flat Belts and many other industrial rubber and non-rubber supplies. Look for him in the Yellow Pages under "Rubber Goods" or "Rubber Products."

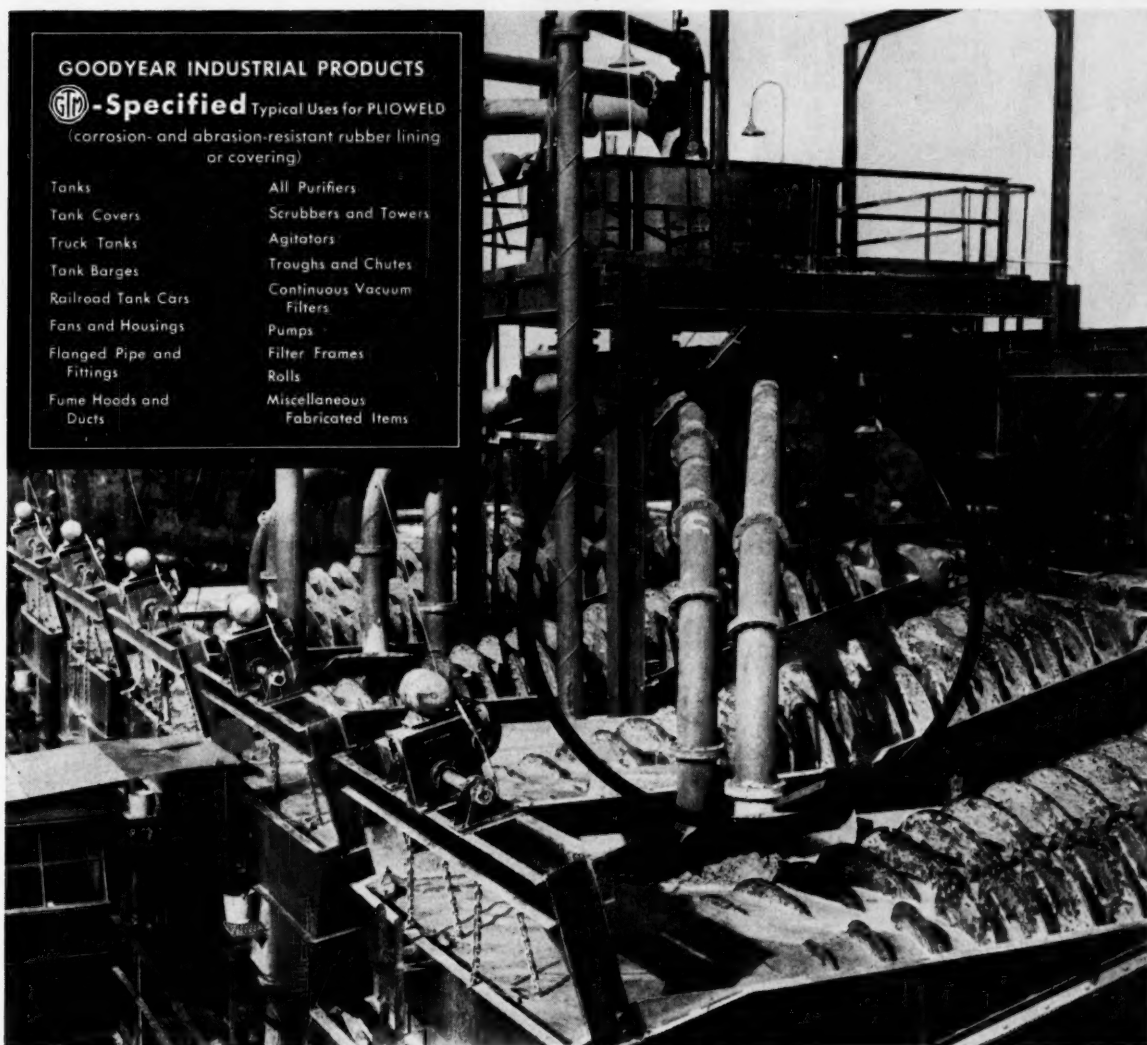
### GOODYEAR INDUSTRIAL PRODUCTS



#### -Specified Typical Uses for PLIOWELD

(corrosion- and abrasion-resistant rubber lining or covering)

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Railroad Tank Cars	Continuous Vacuum Filters
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PLIOWELD BY

# GOOD YEAR

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**THE GREATEST NAME IN RUBBER**



Do you think hi-fi owes its present popularity entirely to electronic marvels? Take another look through the eyes of Product Editor Arne.

## Resins Spin Quality Into Hi-Fi Sound

**T**O PRODUCE about 250 million high-fidelity records in 1959, record makers will use about 40 million lb. of vinyl resin and 5 million lb. of styrene resin.

So well do these materials meet the severe demands associated with high-fidelity (hi-fi) and stereophonic reproduction that they have taken over the whole record market. In fact, there could be no market without them because shellac composites, used formerly, sadly lack high-fidelity qualities.

Here's what high-fidelity demands of record compounds:

- **Moldability**—Low viscosity at molding temperature to minimize cycle time yet still reproduce accurately up to 350 grooves/in.

- **Toughness and resilience**—Withstand 100 playings without damage from needle pressures that average 26 tons/sq. in.

- **Smoothness**—Freedom from discrete particles which can cause bumps in the grooves and needle noise.

- **Strength**—Ability to withstand rough handling without breaking. On this one point, vinyl surpasses styrene which is harder, more brittle and, therefore, more likely to break under unusual shock.

- **Reasonable cost**—Both vinyl at 28¢/lb. and the less dense styrene at 31¢/lb. meet cost requirements.

- **Grooves Set Need**—Requirements such as these stem from the nature of grooves used for both standard long-playing high-fidelity records and for stereophonic records.

By decreasing record speed from 78 to 33 $\frac{1}{3}$  rpm., record makers shortened the wave pattern for a given frequency. At the same time, groove paths became more intricate, increasing

potential wear from needles.

Whereas, the 78-rpm. grooves measured 0.005-0.006-in. wide by 0.0025-0.003-in. deep, the 33-rpm. grooves measure only 0.003-in. wide by 0.0015-in. deep. Distance between grooves has decreased from 10-15 microns to 5 microns; number of grooves per inch has risen from 100-140 range up to 200-330.

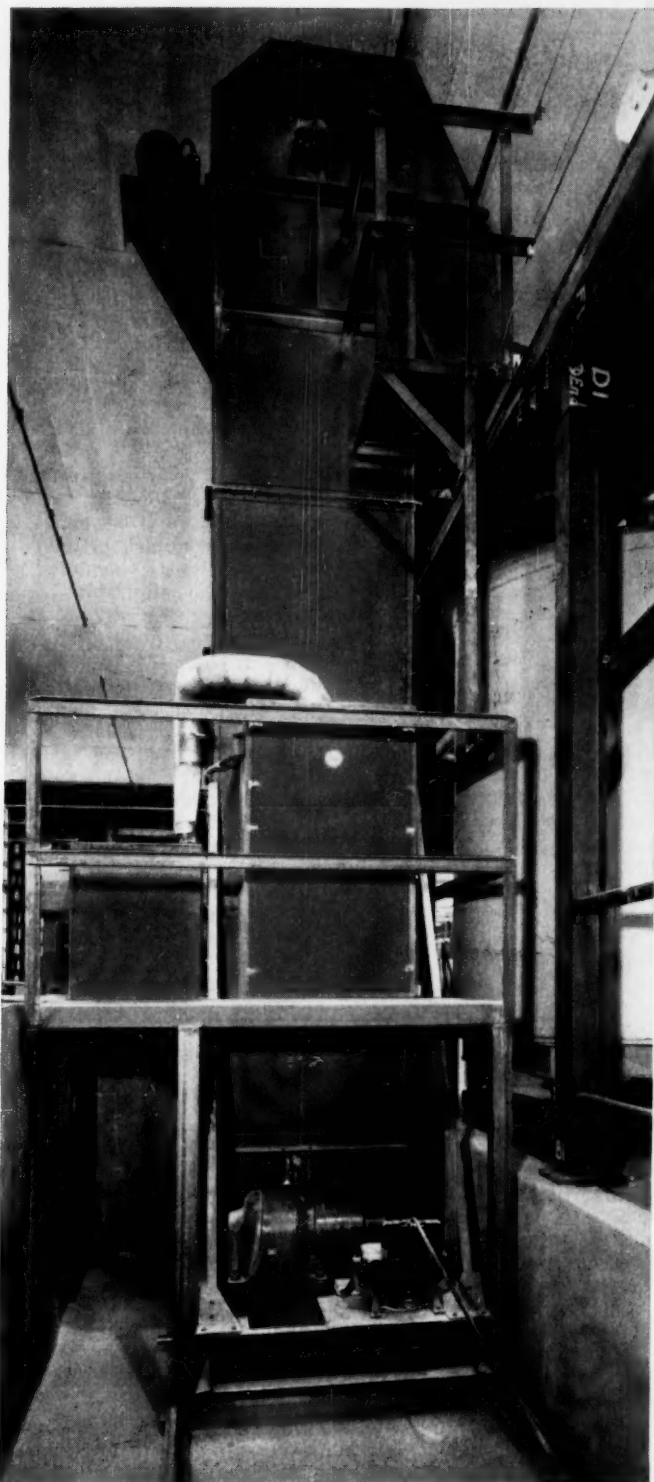
Stereophonic's groove structure differs from monophonic by having variable depth and, thus, size. In turn, this calls for reduction of the needle size from 1 mil to 0.7 mils which raises contact pressure to something like 52 tons/sq. in.

Such drastic changes in groove dimensions and characteristics explain why groove bumps caused by discrete particles can no longer be tolerated if noise is to be controlled.

- **Resins Meet Need**—Both vinyl and styrene resins have proved



No assembly problems with bucket elevators **LARGE** or **SMALL**!



**TRAVELING BUCKET ELEVATOR.** This Link-Belt centrifugal discharge bucket elevator, mounted on a steel, self-propelled carriage, travels along rails and serves a line of processing tanks.

## LINK-BELT makes all elements for bucket elevators

### RESULT:

**easier installation  
smoother performance**

If bucket elevator components don't match perfectly, time and effort needed for assembly can send installation costs skyrocketing. And if misalignment isn't corrected, it soon shows up in bucket and casing wear, undue drag and friction, excessive maintenance and downtime.

### Integrated Components

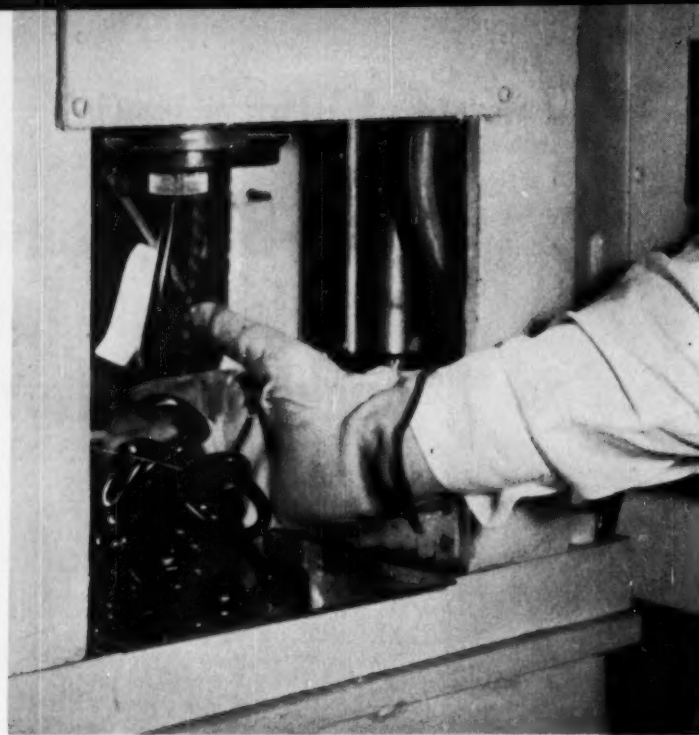
Link-Belt prevents these costly installation and operational headaches . . . eliminates them in the factory, not in the field. Making *everything that goes into a bucket elevator*, Link-Belt carefully designs, manufactures and integrates all components for perfect, ready alignment. As a result, unnecessary erection costs and difficulties are avoided . . . efficient, long-lasting elevator performance is assured.

### One-Source Service

Equally important, the completeness of Link-Belt's line makes it easy to select the proper type bucket elevator and components best suited to your material and capacity requirements. Link-Belt will erect your elevator and accept full installation responsibility. For complete details, contact your nearest Link-Belt office.

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**PREPLASTICIZER** preheats vinyl pellets, granules or flash to a uniform temperature for molding, gives uniform high-quality records.

excellent performers with these new groove configurations up to the 100-play benchmark set by the industry.

However, if put to an endurance test, the harder, brittle styrene would sustain more damage by needle wear and chipping than the tougher, more resilient vinyl. On the other hand, that very hardness gives styrene an edge in true reproduction of sound. Under repeated playing, styrene will wear less than the more elastic vinyl, will retain truer reproductive quality.

Union Carbide Plastics Co. is a major supplier of record-molding compound with its VYHR polyvinyl chloride-polyvinyl acetate copolymer. Other suppliers of vinyl include B. F. Goodrich, Monsanto, Borden, Firestone, Kaiser Chemical. Important polystyrene sources are Union Carbide Plastics and Monsanto.

► **Closer Look at Vinyl**—Composition of the basic vinyl copolymer runs about 86% polyvinyl chloride (PVC), 14% polyvinyl acetate (PVA). The PVA plasticizes the PVC which by itself is too stiff to mold.

Present proportions of these two constituents of the copolymer actually represent progress

toward stiffer compounds made possible by improved molding methods. Stiffer molding compounds coupled with higher molding pressures assure that resin will be forced to fill grooves as resin advances across mold, rather than squirting across with the possibility of bridging grooves and filling them incompletely.

Union Carbide Plastics Co. cites the narrow plasticity range of its current VYHR resin as one of the company's most important research accomplishments. Through quality control methods, Carbide narrows the plasticity range by producing a copolymer with uniform molecular-weight distribution. This assures that successive batches of resin from day to day will soften within the same narrow temperature range during molding.

► **In Addition to Resin**—For highest-quality reproduction of sound, record material contains about 87% basic copolymer, 10% straight PVC diluent, about 1% finely ground colorant such as carbon black, and approximately 1½% stabilizer such as lead or cadmium stearate.

Heat of processing tends to liberate HCl or Cl<sub>2</sub> from the resin. Left to itself, this decom-

position is autocatalytic. But the stabilizer prevents this by accepting the liberated gas.

At times, molders lower cost by adding extenders or fillers where sound reproduction standards are less rigorous.

► **Compounding**—Larger record manufacturers often mix their components in a Banbury at rates up to 6,000 lb./hr. From there, the mix goes to a roll mill which sheets and scores the material into plastic "biscuits" which serve as feed for molds.

Smaller operators often mix components in extruders which turn out about 250-500 lb./hr. Their dies may turn out either sheets for biscuit making, or pellets.

Compounding temperatures are between 317-336°F. At this level, danger of vinyl decomposition is not particularly critical and the operation is completed well within the allowable 15 min.

► **Fabrication** — Compression molding can be used to make either styrene or vinyl records. Injection molding is an alternate method for styrene but, to date, cannot be used for heat-sensitive vinyl. Under sufficient heat to produce the required fluidity, vinyl will decompose; addition of plasticizer would degrade the product.

Styrene for injection molding is heated to 470-510 F. then rammed through a nozzle at 10,000-15,000 psi. in sufficient quantity to just fill a closed-side mold. Mold temperature is a constant 165-185 F. and effective pressure in mold is 5,000-9,000 psi.

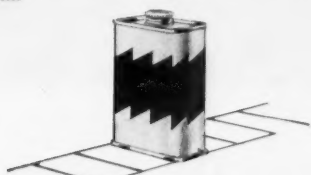
In compression molding of vinyl, a biscuit of material preheated on steam table to 270-320 F. is placed in an open-side mold between the steam-heated jaws of a hydraulic press at 1,200-2,000 psi. for about 40 sec. After cooling to 90 F. to set the final shape, record is removed and trimmed.

Some 40% of molders now preheat molding compound with an electrically heated vessel, called a pre-plasticizer. Taking pelleted or granular feed, or flash trimmed from records, this unit improves uniformity of temperature and composition of resin entering mold.

# Continental "F" style cans make displays that sell

## Easy stacking

"F" style cans have a recessed bottom that fits securely on top of can below. Floor and counter displays stay attractive no matter how high you stack them.

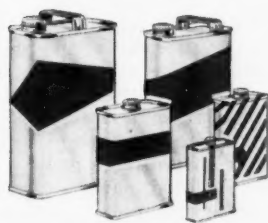


## Save shelf space

Oblong "F" style cans fit together snugly without lost space per shelf foot, get greater emphasis on *your* product. It's easy to create mass displays that create impulse sales with "F" style cans.

## Superb lithography

Continental's excellent lithography gives your product sparkling sales appeal. Broad can surface allows more display space for a powerful sales message.



## Sizes to fit

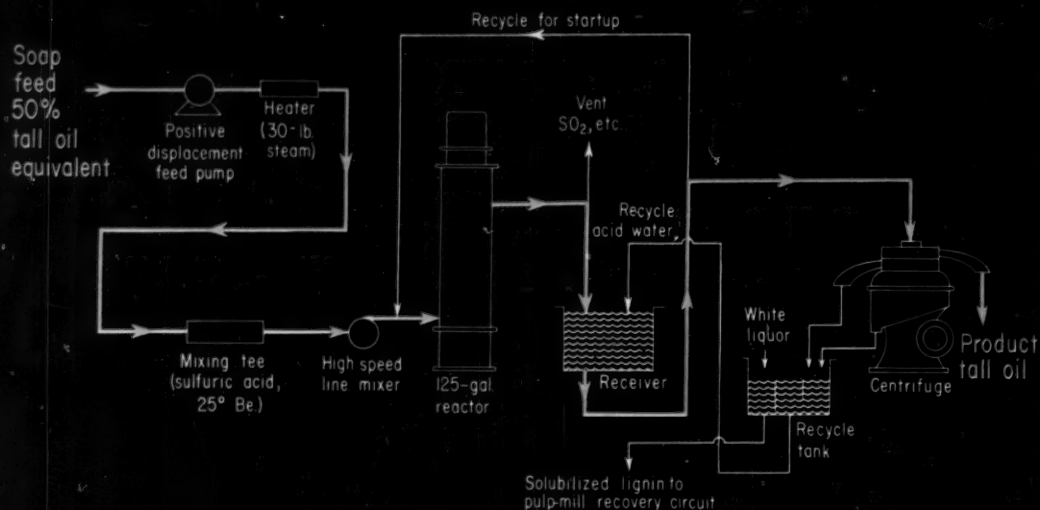
Displays pay off when the customer sees what he wants. Continental "F" style cans are available in five convenient sizes ranging from eight ounces to one gallon.



**CONTINENTAL  
CAN COMPANY**

Eastern Division: 100 East 42nd Street, New York 17  
Central Division: 135 South La Salle Street, Chicago 3  
Pacific Division: Russ Building, San Francisco 4  
Canadian Division: 5595 Pare Street, Montreal, Que.





## Continuous Recovery Boosts Tall Oil Profits

**Higher recovery, better product, lower cost—a hard-to-beat package of benefits—spark shift toward continuous hydrolysis of black liquor skimmings.**

Challenge a chemical engineer to improve a batch operation and most likely he'll streamline it into a more profitable continuous setup. At least that's what he has been doing with the hydrolysis of rosin and fatty acid soaps skimmed from kraft-process black liquor.

Between 50 and 60 U. S. processors hydrolyze this soap mixture with sulfuric acid to form the rosin-acid, fatty-acid material known as tall oil. And roughly 20% of these now have swung over to continuous systems that decrease labor and production costs, improve recovery and quality of tall oil and even reduce capital investment in some cases.

► **A Matter of Hours** — Using batch methods, the processor requires some 6 hr. to hydrolyze his soap. Then, he must settle the mixture for 12-24 hr. to separate out product tall oil on top of tank.

Because batch plants lack precise control of hydrolysis reaction, product may have high

soap content. Or mineral-acid content may be high because gravity settling is inefficient. Either condition produces trouble.

Tall oil with high soap content entrains water and lignin. During subsequent fractionation the water and soap produce foam while lignin coats tower internals with a hard, difficult-to-remove substance. If soap content is low, mineral acid content will be high greatly increasing the corrosiveness of the tall oil.

► **A Matter of Minutes** — You can see how applied chemical engineering converts this hours-long process to a minute-long basis in a system such as St. Marys Kraft Corp., a subsidiary of Gilman Paper Co., operates at its St. Marys, Ga., kraft paper mill.

In a short 4-5 min. pass through the system, St. Marys completely converts soap to finished tall oil. Product quality? Less than 2% water, 0.05-0.16% lignin, 25-50 ppm. mineral acid

and no soap (at normal throughput rates).

Furthermore, St. Marys now recovers 95-98% of available tall oil, some 5-8% higher than maximum recovery obtained with old batch operation. And the production cost? Down roughly 80-90%.

► **How It's Done**—Secret of St. Marys' superior performance lies in system's ability to hydrolyze the soap rapidly to close quality tolerances and then immediately to separate the product cleanly from the reacted mass. Low cost stems, in part, from use of waste acid.

Accurately proportioned streams of dilute acid and slightly diluted soap meet under violent agitation that provides rapid dispersion. Then, after brief contact under milder conditions to permit completion of the hydrolysis, reacted mass passes through centrifuge that separates out product tall-oil stream.

► **Control Feed** — St. Marys draws feed soap from a black liquor skimming system via settlers which concentrate it to 50% minimum equivalent tall-oil content. Below 50% oil content, soap consumes too much acid. And it is more difficult



Fig. 2108—Monel or Nickel "Y" Valve for 150 pounds W.P. Outside screw rising stem and yoke. Screwed ends. Flanged end or socket welding end valves can be supplied.

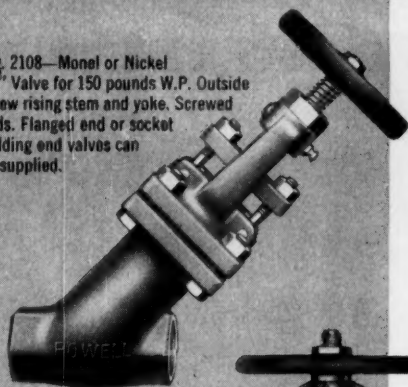


Fig. 2453 SG—Large size O.S. & Y. Gate Valve for 150 pounds W.P. Solid wedge disc. Can also be furnished with split wedge disc. Dimensions conform to latest standards.

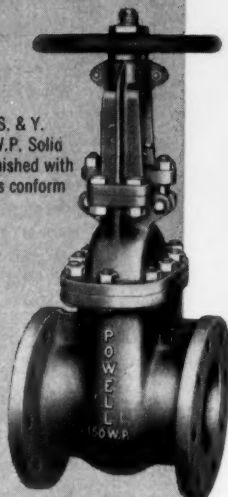


Fig. 1836—Monel Metal  
Fig. 1839—Nickel  
Small Union Bonnet Globe Valve for 200 pounds W.P. Available with screwed, flanged or welding ends; also in angle pattern.

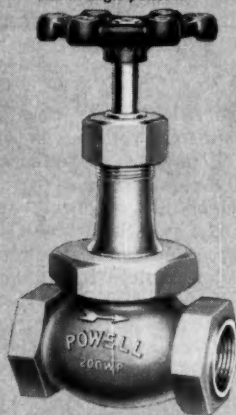


Fig. 1843—Monel Metal. Fig. 1845—Nickel. Small size Check Valve for 200 pounds W.P. Screwed-in cap. Has straightway flow area through valve body when disc is in wide open position. Can also be supplied with flanged or socket weld ends.

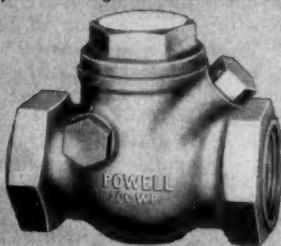


Fig. 2493—Bolted flanged bonnet Gate Valve for 150 pounds W.P. Outside screw stem rises through revolving bushing in upper yoke. Interchangeable solid or split wedge discs. Screwed or socket weld end valves also available.

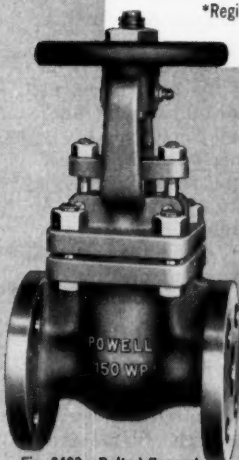


Fig. 1828—Monel Metal  
Fig. 1830—Nickel Inside screw rising stem Gate Valve for 200 pounds W.P. Accurately guided solid wedge disc. Also available with flanged or socket weld ends.

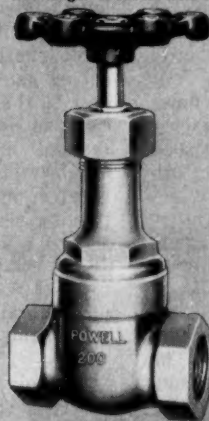
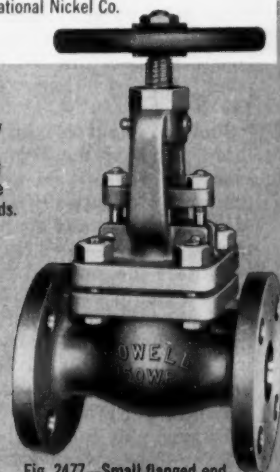


Fig. 2477—Small flanged end, outside screw rising stem and yoke Globe Valve for 150 pounds W.P. Bolted flanged bonnet. Can be furnished with screwed or socket weld ends. Angle Valves available.



# POWELL

## NICKEL and MONEL\*

### VALVES

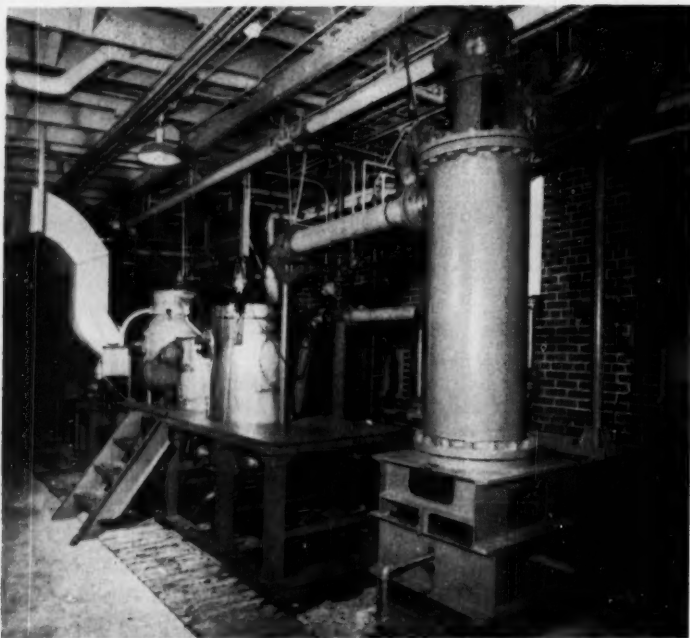
### *for Chemical and Process Industries*

We have produced a wide line of NICKEL and MONEL\* METAL VALVES. All are ready for immediate delivery!

When your flow control requirements call for Nickel or Monel\* Metal Valves your local Powell Valve Distributor is the man to see. There's one located in all principal cities. Or write to us for complete information.

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CONTINUOUS tall oil process takes little space at St. Marys Kraft plant.

to make good quality tall oil.

Entering system at 140-160 F., the 25 gpm. soap stream undergoes dilution with 2 gpm. of hot water (190 F.) introduced either side of the variable-speed, positive-displacement feed pump. Then, direct injection of steam into line boosts temperature to required level for reaction (approx. 180 F.).

► **Short, Violent Mixing** — Diluted, hot soap flows through a glass tee where it mingles with a stream of dilute sulfuric acid. Mixture of acid and soap passes through a high-speed line mixer to agitate the material violently for maximum dispersion.

Discharge from pump flows into bottom of 125-gal. reactor where intimately mixed soap and acid have time to react under mild agitation.

During reaction, temperature rises 5-10 deg. F. but system is designed to permit holding temperature within  $\pm 1^\circ\text{F.}$  of the optimum point. Should temperature exceed 200 F., tall oil oxidizes and deteriorates. Too low a temperature prevents completion of reaction, forming emulsions which lower yields by

discharging from centrifuge with waste-acid phase.

► **Vent Gases** — Overflow from reactor goes to a vented receiver tank. Here,  $\text{SO}_2$ , traces of  $\text{H}_2\text{S}$  and mercaptans formed during reaction are removed from system by suction fan. Any further trace of gases remaining are removed as they escape from the liquor at the centrifuge, at recycle liquor tank and final tall-oil storage tank.

A 30-50-gpm. stream of acid water recycling from centrifuge also flows into receiver tank. A level controller on receiver tank regulates flow of acid-water recycle, thereby assuring that receiver can deliver 80-100 gpm. flow to the centrifuge.

► **On to Separator** — Mixture of reacted material and recycle acid water is withdrawn from receiver by a centrifugal pump feeding centrifuge. Inside centrifuge, under forces up to 10,000 g at periphery, reaction products separate into three phases: tall oil, lignins and acid water, and heavy solids and acid water.

Tall oil passes through a receiver on its way to storage at 12 gpm. (5,000 lb./hr.) rate. The

other two phases discharge into recycle tank.

From this tank, acid water recycles back to the reactor receiver. Any heavy solids present settle in recycle tank where they remain until periodic washout.

Lignins float off with excess acid water overflowing into waste tank. Here, white liquor from the pulp mill neutralizes the waste converting the lignin to soluble salt. Then, neutralized or slightly alkaline material goes to pulp-mill recovery system.

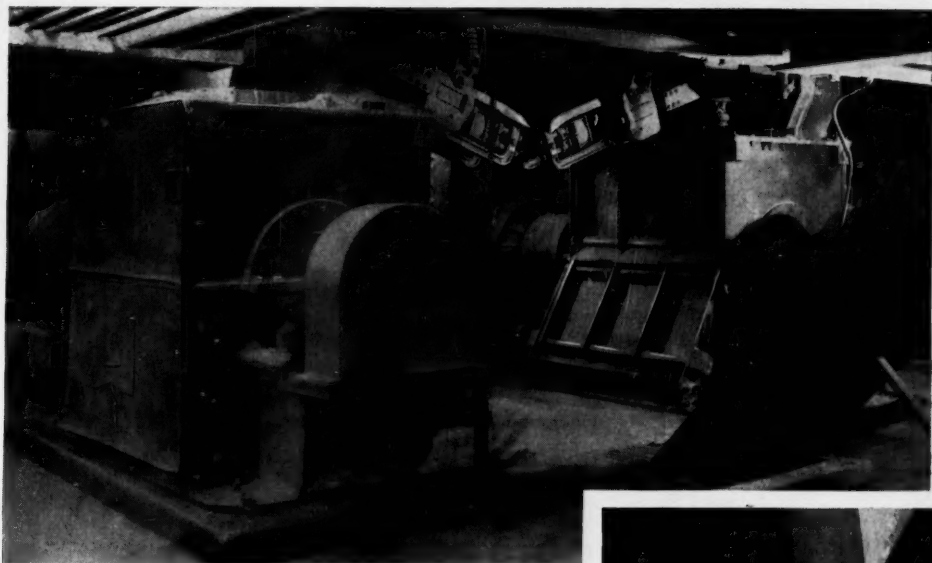
Operation of centrifuge as a three-phase separator is considered vital to the success of this continuous system. A two-phase separation either puts the lignin at the bottom of the dilute acid phase or between the oil and acid water as an interphase.

In the first situation, any centrifuge would soon plug; in the second, the lignin would contaminate the tall oil. In conventional batch systems the interphase presents a serious disposal problem and loss of valuable crude tall oil and salt cake.

► **A Word About Cost** — Capital investment for a continuous tall oil plant may be more than, equal to or less than a batch plant, depending on local conditions. DeLaval Separator Co., engineers and constructors of St. Mary's complete continuous system, reports that investment cost for a 5,000-lb./hr. plant will run \$150,000-200,000, including building and tankage.

If plant uses fresh acid, operating cost runs about \$6.10/ton of tall oil. However, St. Marys and two other plants among the five DeLaval has installed use waste sulfuric acid from manufacture of chlorine dioxide bleach. Then, operating cost drops to the amazingly low range of \$1.33-1.85/ton of tall oil. To realize this advantage the two other DeLaval installations are designed to convert to waste acid soon.

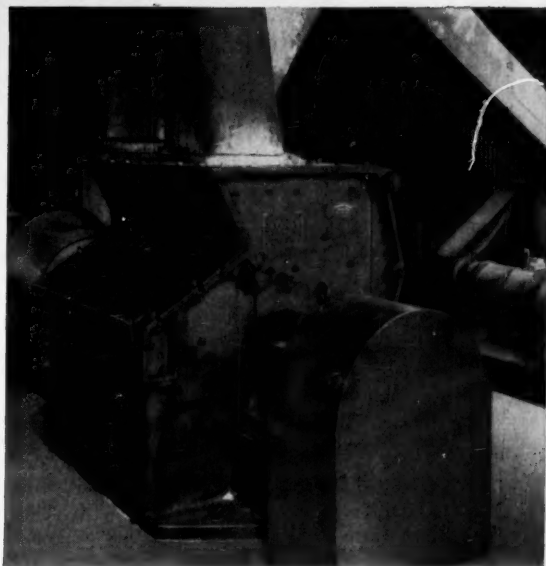
Use of waste acid solves a serious acid-disposal problem, produces lighter-colored tall oil and saves enough operating cost to pay off  $\frac{1}{3}$  to  $\frac{1}{2}$  the capital investment per year.



**Pictured at left and below are Jeffrey Swing Hammer Pulverizers—a popular type crusher in the chemical field. The units at left are fed by Jeffrey vibrating feeders. Jeffrey makes a complete line of auxiliary equipment to handle feed to crushers and dispose of material being discharged from them.**

For reduction of every conceivable material

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Jeffrey engineers will gladly advise you on your crushing needs. Write to The Jeffrey Manufacturing Company, Columbus 16, Ohio.



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## Closed-Loop Control Will Become a Reality in 1959

Climaxing years of research and development, 1959 will witness the final closing of the process control loop: Computers will take over the decision-making and corrective steps traditionally performed by human process operators. Close on the heels of the New Year, several chemical and petroleum companies announced that computers they are installing will be in full control of manufacturing processes by the year's end.

In the latest announcement, B. F. Goodrich Chemical says that it expects to be producing vinyl chloride monomer on a "fully automated" basis by mid-year at its plant at Calvert City, Ky. Goodrich is installing an RW-300 digital computer (manufactured by Thompson-Ramo-Wooldridge Products Co.) on a process specifically designed for computer control.

Monsanto Chemical Co. has already declared that it will operate an existing manufacturing process on full computer control by the latter part of 1959. Monsanto will also use an RW-300 computer, but will not disclose the location of the plant or the process involved.

► **More Digital Control** — The Texas Co. will soon have a catalytic polymerization unit at its Port Arthur, Tex., refinery under automatic control, probably within the next two months.

The RW-300 Texaco is employing is said to be the first digital computer engineered specifically for automatic control of a refinery process unit. Computer will monitor more than 100 variables in the plant and convert the analog input data to digital form. It will then analyze the information and pick the optimum conditions of operation. The RW-300 transmits electrical impulses that will automatically adjust valves and set-points of conventional controllers. Computer is transistorized and is no bigger than an office desk.

Riverside Cement Co. has already installed an RW-300 at its Oro Grande, Calif., cement plant, intending to gradually bring the plant under fully automatic con-

trol. Initial step for the computer is data logging.

► **Different Approach**—Sun Oil is installing an Opcon control system (*Chem. Eng.*, Feb. 9, 1959, pp. 64-66) at its Marcus Hook, Pa., refinery to control a butane fractionation column.

Developed by Westinghouse, the Opcon system operates without a mathematical model (such as used in an RW-300), depending instead on built-in "logic." At Sun's refinery, the computer measures the input of feed to the fractionator, flow of steam to the reboilers and outflow of products in terms of dollar-value. After making a "few simple calculations," the computer transmits its profit-rate calculation to the optimizing section for decision-making and control steps.

## A-Bomb May Be Key to Unlocking Shale Oil

Latest proposal in a long series of schemes to utilize the vast shale-oil deposits in this country comes from the Atomic Energy Commission and Bureau of Mines. In a two-day meeting in Dallas, Tex., called by AEC and Bumines, representatives of the oil and chemical industries heard the outlines of a test program aimed at commercializing shale oil by shattering shale formations with an atomic bomb followed by thermal recovery.

According to proponents of the scheme, a single 10-kiloton bomb (equivalent to 10,000 tons of TNT) might shatter 300,000 tons of shale. After subsequent ignition to volatilize blasted hydrocarbon content, shale should yield between 15 to 25 gal. oil per ton, depending on the proximity to the blast. Proponents argue that this would be cheaper than present mining and retorting techniques (*Chem. Eng.*, Sept. 1957, pp. 146-148).

► **Atoms Cost Dollars**—To back up their theories, the AEC and Bumines proposed a \$2.5-million test program at the Dallas meeting—with industry asked to put up \$1.2 million of the cost. Most of industry's tab (around \$1 million) would go for site preparation and oil recovery research after the blast.

Probable site of the test blast

would be Piceance Creek Basin in Colorado, on either government or privately owned land. Initial reaction among industry men was cautious. As one engineer from a major oil company put it: "The program looks promising, but we are in no hurry to commit ourselves until we have heard more."

Even if private industry agrees to put up its half of the test money, the program probably won't get under way until at least 1960. The U. S. has banned all atomic tests until next Oct. 31. And the diplomats at the current Geneva Atomic Weapons Conference could conceivably agree to ban all future atomic tests—even for peaceful uses.

## NEWS BRIEFS

**Thermoelectric Light:** Westinghouse has now unveiled a "hot-cold-light" panel which combines thermoelectric heating and cooling and electroluminescent lighting. Not yet a commercial product, 6-ft. by 4-ft. wall panel can light an area while also heating or cooling it. Electric current produces heating or cooling in special solid materials, depending on direction of current. The electroluminescent lighting is produced by exciting a phosphor coating with alternating current.

**Pulp from bagasse:** Crown Zellerbach recently started up a large-scale pilot plant at Camas, Wash., to produce paper pulp from Hawaiian bagasse, waste byproduct of sugar manufacture. Main object of new unit is to prove out economics of process, since technical feasibility has been shown in smaller unit.

**Lower Little-Inch tariffs:** Texas Eastern Transmission has reduced tariffs on its Little Big Inch products line. New rates from Beaumont, Tex., to Chicago are 40¢/bbl. on gasolines and 44¢/bbl. on distillates, a reduction of 8¢ on gasolines and 4¢ on distillates. Comparable reductions for liquefied petroleum gas are also in effect.





## **W-K-M's *Creative Engineering*** **has solved your** **plug valve problem!**

**U**sers of ACF Lubricated Plug Valves are enthusiastic about the performance of their valves.

Whatever the service . . . whether the valves are small or large . . . whatever the lading . . . ACF Lubricated Plug Valves handle the most difficult valve jobs.

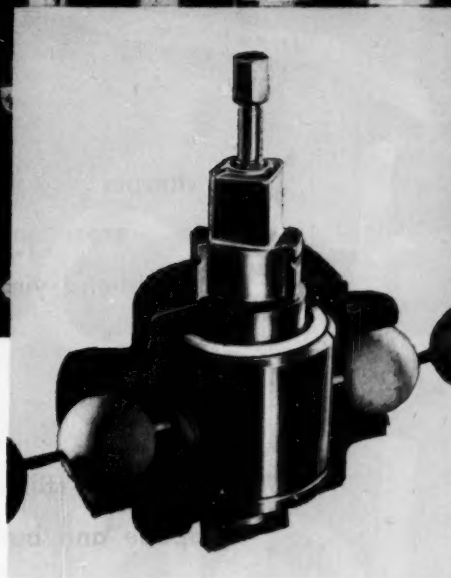
**For example:** The shearing action of the cylindrical plug cuts through tough, stringy slurries clean as a knife—no stoppages, constant flow.

**For example:** You can see excess lubricant as it escapes around the neck of the plug—no build-up of excessive lubricant pressure; no lubricant forced into the line.

**For example:** Special design requires a minimum amount of lubricant for servicing.

**For example:** The valves may be installed in any position, and they fit into the smallest possible space.

Specify ACF when your job calls for plug valves. They'll give you dependable performance, long life and economical operation.



### **acf®** **Lubricated Plug Valves** **with round port, full pipe area**

This is the valve for heavy fluids and ladings. When open, the round port becomes an exact continuation of the pipe. There is no change in velocity, area, direction or cross-section of the lading. There are no pockets to trap the lading, and seating surfaces are sealed away from contact with the fluid flow.

. . .

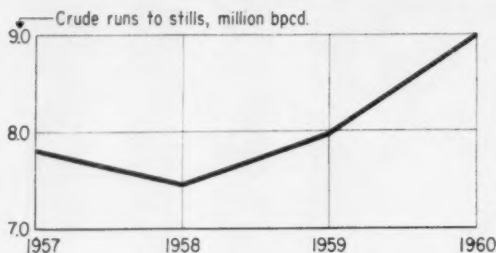
W-K-M provides a complete line of specially formulated lubricants for ACF Lubricated Plug Valves. Write for Catalog 800 for ACF lubricant recommendations.

**WRITE FOR CATALOG 400**

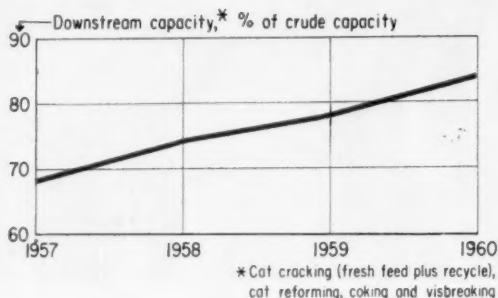
# **W-K-M**

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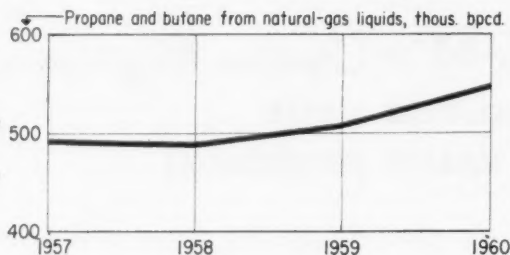
Crude oil refinery  
runs stage upturn . . .



. . . sharper downstream  
processing boosts  
light-end yields . . .



. . . natural-gas liquids  
kick in still more  
propane and butanes



## Oil's Recovery Spawns Chemical Feedstocks

John B. Bacon, Assistant Editor

Petrochemical producers stand to gain a good share in oil's anticipated economic recovery in 1959, and beyond. But just how big a share they can get their hands on depends on a number of things.

A lot of petrochemical feedstocks come from refinery gases and natural-gas liquids. And in many cases, availability of these potential feedstocks depends on how badly refiners need them—chiefly for motor gasoline, avgas and jet fuel. This year and next will bring greater production of propanes and butanes and their

unsaturated cousins, but they will be in strong demand by refiners seeking to boost product quality.

Of vital importance to refiners and petrochemical makers are trends in refinery processing and yield patterns. Some trends will give increased yields of potential petrochemical feedstocks; others will compete strongly for these potential feedstocks.

► **More Made, More Used**—For example, the sharp trends toward more cat cracking and reforming will bring a sizable boost in C<sub>2</sub>'s and C<sub>3</sub>'s, prime

chemical raw materials. But trends in polymer-gasoline processes and alkylation will eat up a lot of it—just how much, nobody's sure. If the supply situation becomes really tight, natural-gas liquids can provide more propane and butanes. But who will get them? It depends on their relative value to the refiner and the chemical manufacturer.

We'll give these competing trends a closer look later in this story. First, though, let's review oil's broad picture. Here are highlights of forecasts for

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of your alcohol needs  
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ISOPROPYL ALCOHOL

METHANOL

# Low cost methanol

It's only common sense to look at *all* costs—alcohol costs, for example. Here is where lower price methanol may be able to deliver real savings over the alcohol you're now using.

How much can methanol help to reduce manufacturing and processing costs?

Plenty, when you consider that the total market for the big 3 alcohols is in excess of 4 billion lbs. annually. Methanol, the lowest cost of the three, often can offer definite advantages when used in place of isopropanol in automotive chemicals, paper coatings, pharmaceutical extractions, metal cleaning and petroleum processing . . . and in place of ethanol in petroleum processing, as a dye solvent, and in film manufacture. What's your share of these potential savings? Write for Product Bulletin S-03-6, or check with your Celanese representative or distributor. They can give you money-saving facts about Celanese Methanol, and answer your specific questions.

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CHEMICALS

## Downstream Processing Splits Out Chemical Feedstocks . . .

(Thousand barrels/day, 1960)

TABLE I

	Crude Processed	Chemical Feedstocks Produced						
		C <sub>3</sub> Olefins	Propane	C <sub>4</sub> Olefins	Isobutane	n-Butane	C <sub>6</sub> Olefins	BTX
Catalytic cracking	3,140	189.2	109.1	204.0	168.0	45.5	119.2	
Catalytic reforming	2,380		162.0		75.6	113.2		
Coking and visbreaking	1,350	18.9	47.9	23.1	8.8	23.4	24.7	
Solvent extraction	107							53.5
Crude distillation	9,200		26.7		22.0	102.0		
Total feedstock produced		208.1	345.7	227.1	274.4	284.1	143.9	53.5
Total feedstock recovered		177.0	310.5	215.5	260.5	270.0	143.9	53.5

Source: Universal Oil Products

## . . . Although Other Refining Soaks Up Some of Them

(Thousand barrels/day, 1960)

TABLE II

	INPUT				OUTPUT
	Propylene	Butylene	Isobutane	n-Butane	
Alkylation	0-88*	220-125*	233-265**		360-380
Catalytic polymerization	124-128	82-79			135-140
Butane isomerization				5-7	5-7
Total input	124-216	302-204	233-265	5-7	

Source: Chem. Eng. estimates; \*Based on 1.73 bbl. alkylate per bbl. olefin feed (propylene content, 0-40% of olefin feed); \*\*Based on 1.12 bbl. isobutane needed per bbl. butylene, and 1.20 bbl. isobutane needed per bbl. propylene.

## Natural-Gas Liquids Kick in Still More Propanes and Butanes

(Thousand barrels/day)

TABLE III

	1957	1958	1959	1960
Propane	250	251	267	286
Butane	155	157	169	179
Isobutane	30	32	34	35
Total LPG	435	440	470	500
Butane from natural gasoline	50	45	47	53
Total propane and butane from natural-gas liquids	485	485	517	553

Source: Chem. Eng. estimates

1959, and of the present situation:

- Demand (see table IV, p. 94) is distinctly a bright spot. Total demand (including exports) and domestic demand this year will be up 4.0 and 4.3%, respectively.

- Total crude and products inventories at the end of last year showed a welcome decline from 841 million bbl. Of this, product stocks are 563 million bbl., up slightly from 559 million bbl. a year earlier. Actually, however, production and refinery runs have been down, and total imports at an all-time

high; so it's a good bet that refined stocks, especially, reflect high imports.

- On the darker side, oil men can expect to pay a 5% higher wage cost because of wage concessions won by oil and chemical unions. And in the face of rising costs, producers are trying their best to prevent a further widespread break in crude prices. This time it's Caribbean and Middle East crude prices that may trigger a fall.

- Natural-gas growth dims the market outlook for some oil products—particularly light and heavy distillates. Marketed

production of natural gas should rise from about 11.2 MMcf. in 1958 to 11.6 MMcf. in 1959. With reversal of the Memphis decision, and increased plant and pipeline building sure to follow, natural gas will expand its markets even more.

But here's one point of key interest to chemical users of natural gas. Gas prices have been rising steadily; and natural gas as a chemical raw material may price itself out of the market, especially in areas where coal could become an economical source of synthesis gas. (Continued)



Milestones In Hydride Chemistry

# On Stream!

## New MHI Sodium Borohydride SWS\* lowest cost borohydride available

### \*SWS—Stabilized Water Solution!

A new low cost form of sodium borohydride is now available in large commercial quantities from Metal Hydrides Incorporated. In this new form, the **contained** sodium borohydride is priced at less than half that of the pure material. MHI Sodium Borohydride-SWS is a stable, aqueous caustic solution of sodium borohydride. The sodium borohydride content is about 12 weight per cent. This should be good news for chemical processes waiting for a lower cost borohydride product.

MHI Sodium Borohydride-SWS is an effective agent for the reduction of carbonyl groups to alcohols. With most aldehydes and all ketones tested, good yields of alcohols resulted. The reduction reaction of aldehydes takes place faster than

condensation or polymerization reactions which might be expected in the presence of strong caustic. This means that MHI Sodium Borohydride-SWS can be used to clean up small amounts of carbonyl and peroxides in organic products.

MHI Borohydride-SWS will also react with many inorganic ions, as does the pure borohydride, without interference from the caustic.

Other suggested uses for MHI Sodium Borohydride-SWS include foaming plastics and silicates; bleaching and stabilizing wood pulps; and treating natural and synthetic textiles.

Easy and safe to handle and use in standard equipment, new MHI Sodium Borohydride-SWS merits your attention. Write for complete information and order your trial quantities now!



CHEMICAL HYDRIDES DIVISION  
***Metal Hydrides Incorporated***

PIONEERS IN HYDROGEN COMPOUNDS  
39 CONGRESS STREET, BEVERLY, MASSACHUSETTS

## Crude Oil Runs Swell to Meet Stiffening Demands

(Thousand barrels/day)

TABLE IV			% Increase
	1958	1959	1958-59
U. S. crude production	6,703	7,280	8.6
Crude run to stills	7,620	8,136	6.8
Total demand	9,272	9,647	4.0
Domestic demand	8,994	9,378	4.3
Gasoline	3,880	3,989	2.8
Kerosene	314	329	4.8
Distillate	1,772	1,844	4.1
Residual	1,423	1,460	2.6
Other	1,605	1,756	9.4
Exports	278	268	-3.6
Imports	1,651	1,558	-5.6

Source: U. S. Bureau of Mines

In certain cases, chemical makers may adopt alternate manufacturing routes to take advantage of refinery gases or natural-gas liquids, including even natural gasoline.

► **Refinery Yield Patterns**—As in the last few years, refiners will add processing capacity chiefly to upgrade gasoline and other products (see *Chem. Eng.*, Mar. 24, 1958, p. 90). Only about 175,000 bbl./day of new crude capacity is due in 1959, compared with about 517,500 bbl./day added last year.

Trends at least through 1960 will be to more cat cracking and reforming, more hydrogen treating (of products and naphthas), increased coking and visbreaking (to boost distillate yield at the expense of residual), more aromatics extraction (paraffinic raffinate going to jet fuel or possibly chemical feedstocks), more alkylation and some pentane and hexane isomerization.

A forecast for 1960 of possible supply and demand for C<sub>3</sub>'s and C<sub>4</sub>'s at refineries is summarized in Tables I and II, p. 92.

Cat cracking will be a source of olefins from ethylene through pentylenes. Alkylation, however, will make a strong bid for C<sub>3</sub>'s, and perhaps an increasing amount of C<sub>4</sub>'s.

As can be seen from Tables I & II, the balance of propylene and butylene in 1960 could vary, in the first case, from a 53,000-

bbl./day availability to a 39,000-bbl./day deficit, and in the second case, from an 11,000-bbl./day availability to an 87,000-bbl./day deficit. (Table I's "Feedstock recovered" less Table II's "Total input.")

► **How About Hydrogen?**—Increased process severity of cat reforming will add to the supply of propanes and butanes. Chief petrochemical raw material from reforming, however, is hydrogen. And increased severity boosts hydrogen yield about 15% when increasing reformat octane number from 85 to 97. In spite of this increase, though, petrochemical producers will probably find themselves using natural gas or oil as hydrogen sources because of the great increase of hydrogen treating at refineries.

► **Aromatic Byproducts**—Refiners have been moving into the benzene-toluene-xylene market in a big way. And one potential source of chemical raw material (besides BTX), is the paraffinic raffinate which accompanies aromatics extraction. This raffinate is largely C<sub>6</sub>-plus paraffins. However, it has a definite value for a refiner as jet fuel, or gasoline blending stock if he wants to send it through a cat reformer. If he decides not to, it's possible chemical raw material.

► **Natural-Gas Liquids**—Natural-gas liquids are commonly thought of as two components:

liquefied petroleum gas (LPG), comprising largely C<sub>3</sub>'s and C<sub>4</sub>'s, and natural gasoline, comprising C<sub>5</sub>-C<sub>7</sub>'s.

LPG has been a sizable source of petrochemical feedstock; but competing markets are commercial heating and motor fuel blends. Last year, shipments of LPG to refineries for blending stock were down nearly 12%, and an increased amount went into heating and chemical uses.

LPG sales in 1958 were 7.6 billion gal., up 9.4% over 1957. And with the expected general economic recovery and a better heating season, 1959 sales should rise about 10%. Sales to petrochemicals are expected to rise about 5% from 1958's 1.9 billion gal. Polyethylene capacity is overgrown now, so a lot may depend on market openings for polypropylene and, perhaps, polybutadiene.

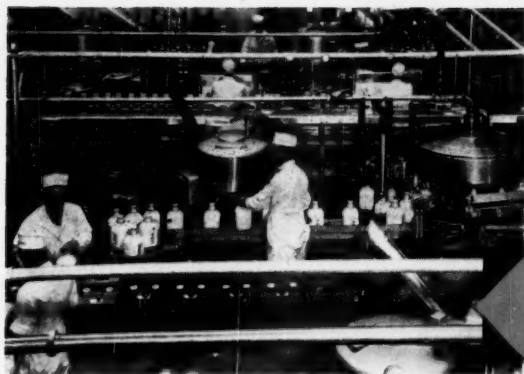
LPG sources are roughly 75% from field-stripping plants and 25% from refineries (LRG). However, in recent years, a larger percentage has come from refineries because of increased production of light ends. Refiners are beginning to groom high-purity propylene streams, and additional butane will be stripped from natural gasoline to further swell LPG stocks.

► **Natural Gasoline**—Natural gasoline has been seeking sorely needed markets in recent years. Refiners have reached limits in using it as gasoline blending stock. It's comparatively low-octane material.

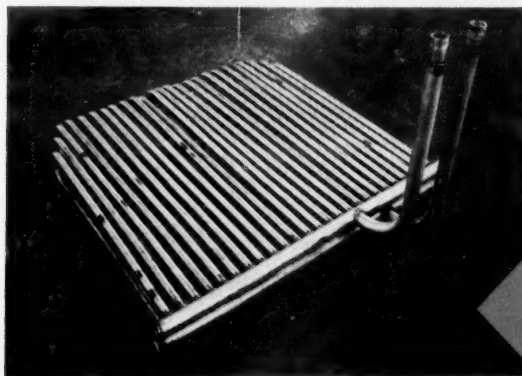
In isolated instances, natural gasoline could serve as a petrochemical feedstock (*Chem. Eng.*, Jan. 12, 1959, pp. 76-78). But what's needed here is extensive fractionation equipment.

Large-scale refiners and field-processing plants, however, can now use such newer processes as catalytic reforming and C<sub>6</sub>-C<sub>8</sub> isomerization to upgrade natural gasoline into a valuable (96-99 Research Octane Number, 3 cc. TEL) blending stock. Last year saw a beginning of this.

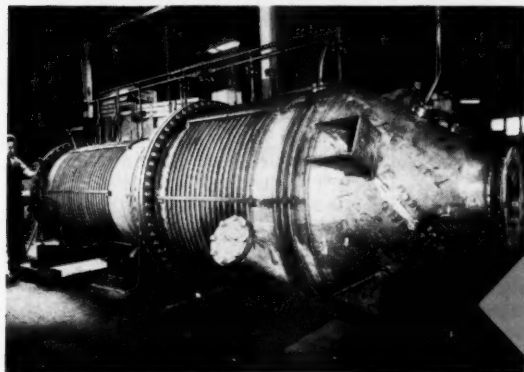
Thus, LPG and LRG will continue to be the chief sources of feedstock for petrochemical makers. But the CPI will have to meet stiff competition from refiners to get all they want.



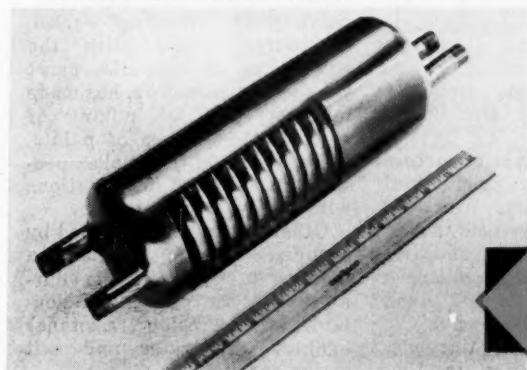
In dairy products, sanitation, non-contamination, heat and cold requirements dictate welded stainless steel tubing.



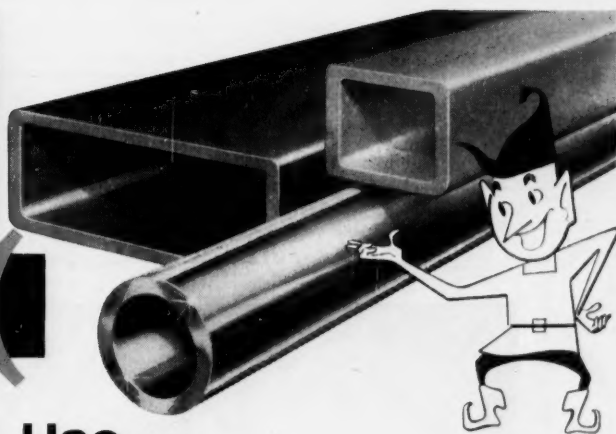
This heating coil of welded stainless steel tubing replaced lead coils and increased the durability and efficiency of the unit.



This all-stainless steel resin distillation unit relies on welded stainless steel tubing for all tubular components.



Liquid sample cooler demonstrates the ready fabrication properties of welded stainless steel tubing.  $\frac{1}{4}$ " OD x 20 ga. Type 316 is coiled;  $3\frac{1}{2}$ " OD x 16 ga. makes up the shell.



## Use **WELDED** stainless steel tubing to resist

- CORROSION
- HIGH TEMPERATURE
- CONTAMINATION

Where applications involve combinations of corrosion, pressure and temperature—where freedom from contamination is a must—where durability and low maintenance are key factors of economy—use Welded Stainless Steel Tubing.

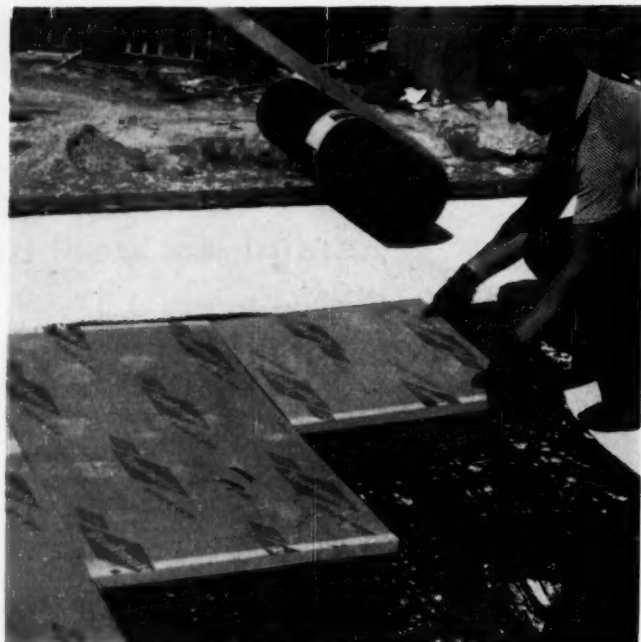
In all these applications for tubing and pipe, the uniformity, concentricity, dimensional accuracy and range of sizes, shapes and grades of welded stainless steel tubing serve best. To be sure—specify welded stainless steel tubing and pipe from your quality tube producer.

**WRITE for  
Bulletin 8591 "Welded Steel Tubing"**



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CLEVELAND 15, OHIO**

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• The Carpenter Steel Co., Alloy Tube Div. • Clayton Mark & Co. • Damascus  
Tube Co. • Jones & Laughlin Steel Corp., Electricweld Tube Div. • National  
Tube Div., United States Steel Corp. • Ohio Seamless Tube Div. of Copper-  
weld Steel Co. • Republic Steel Corp., Steel and Tubes Div. • Revere Copper  
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Tube and T. I. Ltd., (Canada) • Superior Tube Co. • Trent Tube Co., Subs.  
Crucible Steel Co. of America • Wall Tube & Metal Products Co.



### Styrene Foam Bids for Industrial, Home Roofing Use

New insulation designed for use under built up roofs is made of expanded polystyrene boards wrapped in laminated kraft paper. It is said to have one of the lowest heat transmission rates of any commercially available insulation.

Called Roofmate, it holds promise for residential use with gravel roofs in addition to industrial flat or low-pitch roofs. Each 1-in. board weighs about 3 lb.; compressive strength is 3,000 lb./sq. ft.—Dow Chemical Co., Midland, Mich. 96A

### Fine Metal Powders

A thousand times smaller particle size than any previously obtainable.

A newly-discovered method for producing ultra-fine metal powders with particles only a millionth of an inch in diameter—a thousand times smaller than any previously obtainable—promises to open up new processes or application in the

catalytic chemical process, powder metallurgy and other industries.

First of the metals receiving consideration for production scale-up is aluminum. Iron and nickel powders have been made in the same size range and are expected to offer a large number of new magnetic and electromagnetic applications.

Major chemical significance of the powders lies in the potential ability to enter into

or catalyze chemical reactions which the same metals in a coarser state will not do at all or will do only with the application of large amounts of externally supplied energy in the form of high pressure or temperature. In powder metallurgy, they may provide short-cuts to new, exact-composition alloys having superior physical properties over the best we know today.—National Research Corp., Cambridge, Mass. 96B

### Pigment Stabilizer

Permits mass production, long storage of aluminum paints.

A major barrier to vastly expanded industrial use of alkyd-base aluminum paints has been eliminated, according to Alcoa. Their new additive, called Stabilizer No. 5, eliminates the deleafing in alkyd and high-acid varnish vehicles that has prevented mass production and long storage of aluminum paint.

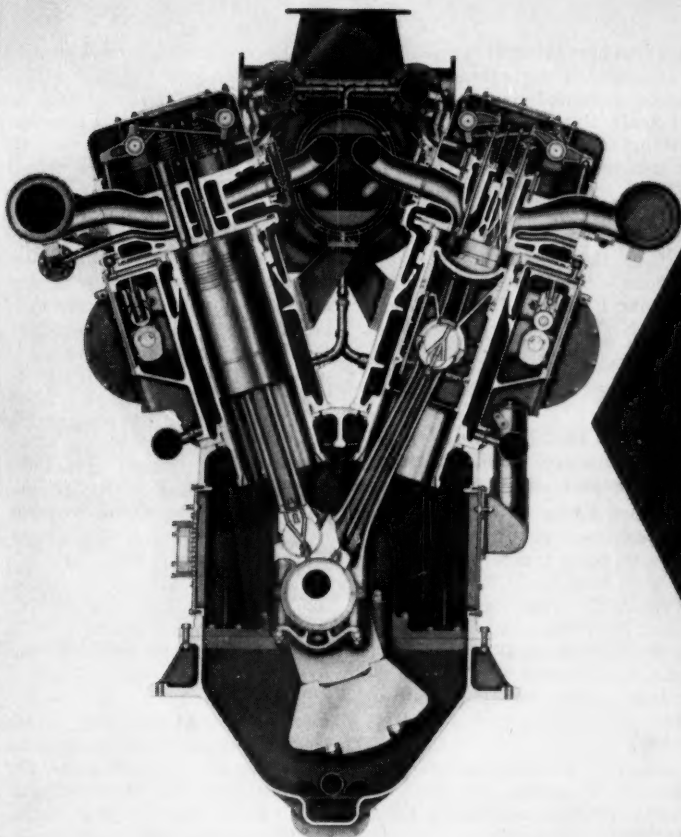
The "leafing" action of aluminum paint is the ability of the aluminum flakes to rise to the surface of the paint film after it has been applied to a surface. The problem encountered to date has been that the high-acid vehicles tended to neutralize this leafing action and hence destroy most of the protective ability of aluminum paint. This "deleafing" action, of course, varies with the amount of acid in the paint vehicle and, therefore, has made necessary the job mixing of most of these types of paints.

The new additive makes possible ready-mixed formulations with acid values up to 28.

Other advantages afforded by Stabilizer No. 5 include a marked increase in the durability of the paint, and doubling of corrosion resistance against salt water and salt water spray.

Only a few ounces of additive





# STOP COSTLY CORROSION

*in Diesel  
cooling systems  
with*

## Chromate Compounds



Transverse cutaway showing part of the cooling system (red) in a typical 4-cycle V diesel. Compounds featuring Mutual chromates protect these vital areas.

Protecting the cooling system of a giant diesel against corrosion is just one of the jobs handled effectively and inexpensively by corrosion inhibiting compounds containing Mutual chromates. Other applications include: cooling towers, air-conditioning systems, boilers and condensers. In virtually every type of recirculating water equipment, you can protect against corrosion best with chromate compounds.

For best results, you should add a chromate inhibiting compound to your recirculating water system from the moment operations start. That way, clean metal *stays clean!* If you add them to older recirculating water systems already coated with rust and scale, they will arrest corrosion.

Compounds containing Mutual chromates offer many advantages: They are stable. They're readily soluble. They're effective against all

types of corrosion and scale forming materials. And they're available in a wide variety, each chemically tailored to a specific task. The best of them have this in common—they're based on Mutual chromates.

For the names of manufacturers of corrosion inhibiting compounds containing Mutual chromates or information on Mutual chromium chemicals, we suggest that you mail the coupon today!

### Mutual® Chromium Chemicals

Sodium Bichromate  
Sodium Chromate  
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Potassium Chromate  
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Koreon (one-bath chrome tan)

**SOLVAY PROCESS  
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- ☐ List of manufacturers of corrosion inhibiting compounds  
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Name

Position

Company

Phone

Street

City  Zone  State

per gallon of aluminum paint are needed to achieve these results. To determine needed amounts for a particular vehicle, simple charts are available from Alcoa.

A clear, amber liquid, the new stabilizer will be manufactured by Alcoa and sold through the company's network of sales offices and distributors. — **Paint Finishes Div., Alcoa Research Labs, New Kensington, Pa.** 96C

#### Fluid Resistance Properties

70-hr. Immersion @ 300 F.		
	Volume Change, %	Hardness Change, Points
JP-4 (jet fuel).....	+100.....	-18
ASTM No. 1 oil.....	+2.....	-5
ASTM No. 3 oil.....	+22.....	-18
MIL-L-7808.....	+64.....	-30
MIL-O-5606(@ 250 F.).....	+50.....	-20
Water (@ 212 F.).....	+3.....	-7

#### Nitrile Silicone Rubber

**First member of new heat- and oil-resistant family now available.**

NSR-X5602, the first product in GE's new family of nitrile silicone rubbers (*Chem. Eng.*, Sept. 22, 1958, p. 94), is now available in evaluation quantities. Described as having intermediate fluid resistance, it will have the widest application of any of the several members of the new oil and heat resistant family of rubber on the way.

It is a 60 durometer, relatively low modulus stock, suitable for such applications as airframe seals, boots, diaphragms and shock mounts, and can be fabricated by extrusion, molding or calendaring.

For applications requiring outstanding high temperature oil resistance, a second compound, NSR-X8701 will be available within weeks. A 70 durometer rubber, it will be suitable for such molded parts as O-rings, gaskets and oil seals continuously immersed at elevated temperatures.

A third nitrile silicone rubber, to be introduced soon, is NSR-X4803. It is an 80 durom-

eter rubber with intermediate resistance to high temperature fluids, designed principally for oil seals for automotive transmissions. It will also be useful in O-rings, gaskets and similar molded, extruded or calendared parts, for use where fluids encountered are not severe in effect or immersion is not continuous. — **General Electric Co., Silicone Products Dept., Watford, N. Y.** 98A

#### Epoxies

**New heat-resistant resin, conductive coating, three new plasticizers.**

A new epoxy resin for use in applications requiring resistance to high temperatures and greater heat stability has been developed. The resin is an epoxy novolac and it differs from conventional epoxies in that it is based on epichlorohydrin and novolac rather than epichlorohydrin and Bisphenol-A.

An experimental material designated X-2638.3, it exhibits more chemical resistance than conventional resins.

Typical uses are in high strength adhesives for metal fabricating, glass reinforced laminates for structural shapes, and electrical printed circuits.

It will sell in the same range

as the company's conventional solid and liquid epoxies which recently were reduced 10 to 20% in price. — **Dow Chemical Co., Midland, Mich.** 98B

Three new plasticizers, all recommended as stabilizers in vinyl formulations, mark Emery Industries' entry into the epoxy-type plasticizer field. Plastolein 9213 and Plastolein 9214 are epoxidized fatty acid esters that contribute to low temperature flexibility in addition to heat and light stability. Plastolein 9232 is a polymeric type featuring extremely low extraction and volatility in addition to a high degree of heat and light stability. — **Emery Industries, Inc., Cincinnati, Ohio.** 98C

Low volume resistivity, exceptional toughness, and excellent adhesion are claimed for Hysol 6251, a new conductive coating based on epoxy resins. It is easy to handle and working time exceeds four hours.

The compound is recommended for rebuilding areas worn away by sliding contacts, and as a conductive base for plating plastics when reliable bonds of the coating to the plastic are necessary.

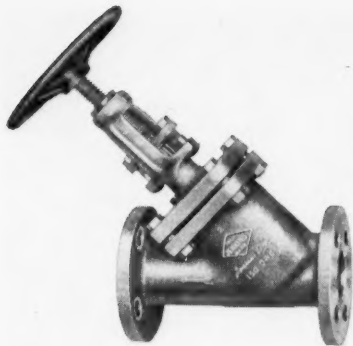
Full cure can be effected in 48 hr. at room temperature or in 7 min. at 300 F. Volume resistivity at 25 C. is .0008 ohm-cm. — **Houghton Laboratories, Olean, N. Y.** 98D

#### —Newsworthy Chemicals—

Page Number is also  
Reader Service Code Number

Styrene foam insulation looks for jobs under roofs.....	96A
Metal powders boast millionth-of-an-inch particles.....	96B
Stabilizer stops deleafing in aluminum paints.....	96C
Nitrile silicone rubber, first of a new family.....	98A
Epoxy bids for tougher thermal, chemical duties.....	98B
Epoxy plasticizers give better vinyl stabilization.....	98C
Conductive coating is based on epoxy resin.....	98D
Kraft paper has stretch needed for forming.....	100A
Polyester makes laminates serviceable at 400 F.....	100B
Foamed metal is nine times lighter than solid cousin....	100C
Isocyanate enamel turns out to be really tough.....	100D
Short-oil alkyd permits low-cost metal finishes.....	100E
Acrylic resin imparts dry strength to paper.....	100F

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A Y Globe that challenges comparison  
shows it pays to

# Specify JENKINS for STAINLESS STEEL Valves, too

Want the "best buy" in Stainless Steel Y Globe Valves? Compare this Jenkins Fig. 1335 with any on the market. You'll conclude that it's hard to beat Jenkins at making valves, no matter what the material.

You'll find genuine superiority of design and construction in the features shown here. But no picture can show the quality of the castings . . . the precision machining . . . the rigid inspection and testing that have gone into this valve. All of these are as important as design and metal alloys in assuring

long, dependable, economical valve service. And, all of them are up to the peak standards for which Jenkins has been known for almost a century.

SEND FOR NEW CATALOG of Jenkins Stainless Steel Valves, in patterns and alloys that satisfy the requirements of practically all corrosive services.

These Jenkins Valves meet valve industry specifications and the high standards established by leading users of stainless steel valves.

**WHEEL** of high strength malleable iron designed for firm grip and easy operation.

**SPINDLE** of large diameter and dense structure has high resistance to wear and torsion strains. Easy, tight closing is assured by long, precision machined thread bearing surfaces. A beveled shoulder provides backseating against inside of bonnet, permitting repacking under pressure.

**PACKING** A Teflon ring in large packing box prevents leakage. Only a minimum load is required on gland, extending service life of packing.

**DISC HOLDER**, held by lock nut, has depth equal to disc thickness, preventing flow of plastic disc. Wide disc retaining nut covers all but seating surface of Teflon disc.

**DISC** is Teflon made by Jenkins

**YOKE BUSHING**, easily renewable. Made of bronze, for ideal thread engagement with stainless steel spindle, to prevent seizing or galling of spindle threads. Bushing of stainless steel is optional.

**YOKE BONNET**, a single unit, has liberal space between yoke arms for easy access to packing box. Tongue and groove joint with body makes a pressure-tight seal with less tightening on the bolts, and eliminates possibility of blowing out the Teflon gasket.

**GLAND** consists of two pieces — gland flange and gland follower — to prevent binding of follower in case gland bolts are tightened unevenly. Crowned surface of flange secures tightness against gland without excessive tightening of gland nuts.

**BODY** Through-port design for full, free flow. Liberal seat height permits repeated refacing. Cast on body are directional arrow and bosses for drain connections. End flanges conform to M.S.S. specifications.

## JENKINS

(LOOK FOR THE JENKINS' DIAMOND)

## VALVES



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☐ Send the new stainless steel valve catalog

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☐ Have a representative call on me

COMPANY .....

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### Formable Paper

Balanced, all-directional stretch allows kraft paper-plastic molding, above.

After two years of development work, the balanced, all-directional stretch necessary for forming can be imparted to kraft paper.

The ridged meat tray shown above is made from the paper sheet laminated with polystyrene. Thermoplastic and paper combinations can stretch as much as 60% during the forming process without breaking.

The development work indicates the forming may be done on mechanical, hydraulic or air pressure presses using male, female, or matched dies. Most work to date has been on an air pressure machine with forming air pressures up to 350 psi., literally blowing the preheated material into a female mold. Prior to forming, the material is preheated to about 300 F.

Called X-Crepe materials, they range in thickness from single ply a few thousandths of an inch thick to multi-ply materials a quarter of an inch thick or more. Addition of plastic to the base material adds extra rigidity and can also provide the inside or outside surface of an object such as a dish or box.—Cincinnati Industries, Inc., Cincinnati, Ohio. 100A

### Polyester Resin

Its laminates retain strength in the 350-400 F. range.

Laminac 4104 polyester resin has been developed for the fabrication of glass-fiber reinforced parts for service at temperatures up to 400 F. The new resin is suitable for applications such as heating ducts, particu-

larly in aircraft, and for other structures subject to considerable heat.

Laminac 4104 is supplied with a relatively high viscosity of 50 poises, and may be thinned with a limited amount of styrene for hand lay-up use without significant sacrifice in hot strength.

Developed specifically for strength retention at the 350-400 F. range, Laminac 4104 has been tested to 400 F. Typical glass cloth or glass mat laminates have adequate initial strength and show no fall off in strength after 96 hr. exposure within this temperature range. Flexural strength and modulus often show a definite increase after the period of exposure.—American Cyanamid Co., New York, N. Y. 100B



### Foamed Metal

Nine times lighter than solid, uses are expected in jet engines.

Foamed metal that resembles a petrified sponge and is nine times lighter than solid metal has been developed by GE's flight propulsion laboratory department at Cincinnati. Called F-alloy, it has shown value in laboratory experiments for use as rubbing seals in high temperature areas of jet engines. The lightweight material improves engine performance in two ways:

First, the lighter weight means that more fuel or payload can be carried.

Second, the foamed metal makes possible closer toler-

ances inside a jet engine, thereby providing better performance.

GE describes the foamed-metal-making technique as much like that for baking a cake. Ingredients are mixed in the right proportions, poured into a pan or mold, then baked at a given temperature. The result is rigid, low density material, so light and porous that cigarette smoke passes through it easily.

Although the technique is still in the development stage, nickel, copper and cast iron have been successfully foamed.—General Electric Co., Cincinnati, Ohio. 100C

### BRIEFS

Isocyanate floor enamel, believed to be the only non-toxic product of this nature developed to date, has proved 15 to 20 times tougher than conventional floor paints. It is said to possess three times the abrasion resistance of all floor coatings tested.—Pittsburgh Plate Glass Co., Pittsburgh, Pa. 100D

New short-oil alkyd, called Celolyn 604, is expected to make possible low-cost metal finishes that are fast drying and durable, based on company's Parlon chlorinated rubber.—Hercules Powder Co., Wilmington, Del. 100E

New acrylic resin for imparting dry strength to paper and paperboard is now available. In addition to strength, it is said to impart faster drainage, thereby enabling increased production rates.—American Cyanamid Co., New York, N. Y. 100F

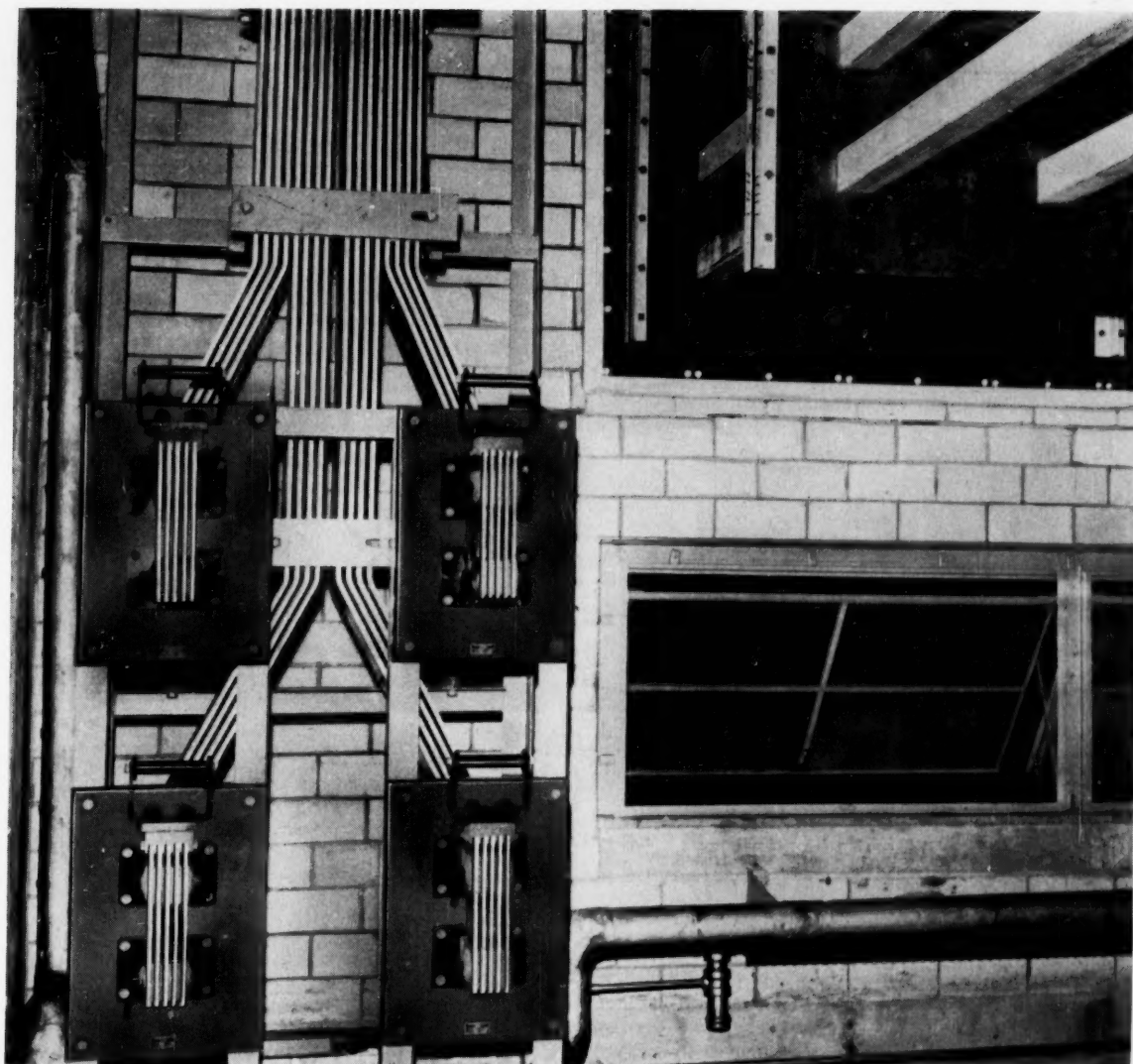
### For More Information . . .

about any item in this department, circle its code number on the

### Reader Service

postcard (p. 213)





Alcoa Aluminum Bus Conductor carries current between rectifier and cell circuit at Solvay Process Division of Allied Chemical Corp., Moundsville, W. Va.

## ALCOA ALUMINUM BUS CONDUCTOR SAVES MONEY FOR SOLVAY PROCESS

Initial savings were in material costs. Aluminum is about 50 per cent lower than equivalent copper. There were savings in installation costs, too: aluminum bus is easier to handle and fabricate, and goes up faster with less labor.

This is the second aluminum bus conductor installation by Solvay Process. The performance and economy of the first led to this

second installation.

Low material costs, low installation and maintenance costs, plus easy-to-make connections, are strong reasons to use Alcoa® Aluminum Bus Conductors. An Alcoa service engineer will be glad to give additional assistance in the design and construction of aluminum bus conductor installations.

Write for a copy of *Alcoa Alu-*

*minum Bus Conductor Handbook.* Aluminum Company of America, 2120-C Alcoa Building, Pittsburgh 19, Pa. A wide variety of sizes are available from Alcoa Distributors.

*Your Guide to the Best in Aluminum Value*

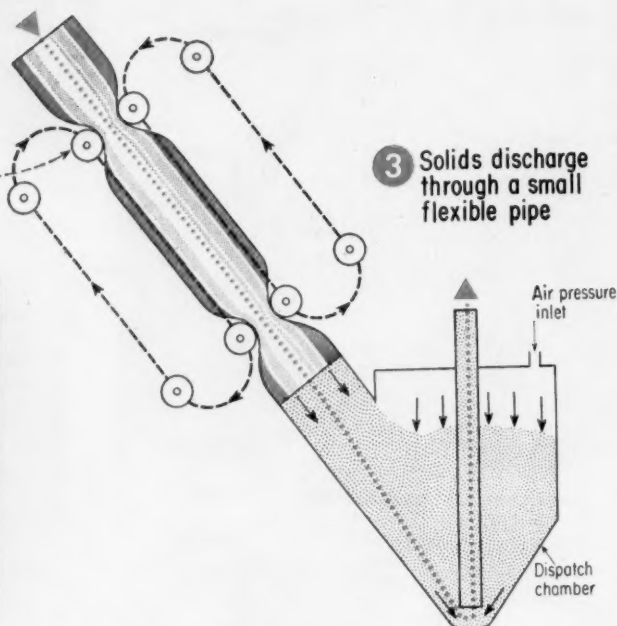
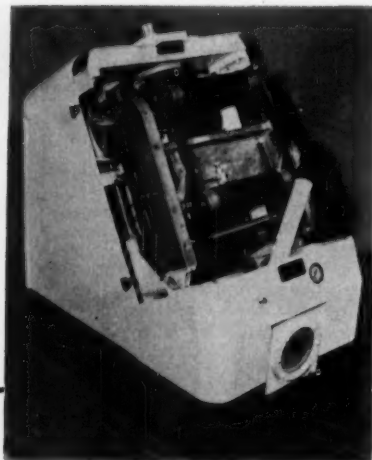


For Exciting Drama  
Watch "Alcoa Theatre,"  
Alternate Mondays,  
NBC-TV, and "Alcoa  
Presents," Every  
Tuesday, ABC-TV

1 Granular material enters nylon tube...

2 ...pinch-off rollers force feed into dispatch chamber

3 Solids discharge through a small flexible pipe



## Novel Feeder Charges New Solids Conveyor

**New, low-cost, pneumatic system moves low-density granular solids through flexible plastic hose. Unit also introduces unique solids feeder.**

Getting granular solids to move continuously from low-pressure to higher-pressure zones has always been a tricky problem. To solve this problem, equipment designers have come up with star feeders, choke screws, sealed drag conveyors and piston-type stokers, to mention a few. Granu-Flow Systems, Ltd. has developed another device to add to this list—the feeding mechanism for their new Dens-Flo Swallow Pump. ▶ **Peristaltic Action is Key**—Dens-Flo pumps are solids-con-

veying systems designed primarily for low-density granular products. As part of the sequence of material flow, feed from storage must be forced into a dispatch chamber that operates at 16 psi. To accomplish this without blowback, Dens-Flo pumps literally "swallow" the charge.

In operation, feed enters the mouth of a flexible, neoprene-coated nylon tube that is a few inches in diameter. Several pairs of chain-driven rollers compress and move down this

tube, thus forming a series of non-returning sealed cavities. Feed trapped in the cavities ultimately drops into the 16-psi. dispatch chamber.

To reduce wear on the flexible tube, other mechanisms continuously rotate it at a rate of 1 rph., and also keep it well lubricated.

▶ **From Chamber to Discharge**—Compressed air maintaining the dispatch chamber's pressure then forces the granular material up through the discharge tube into a 1½-in. conveying line. According to the manufacturer, an air input of 4.25 cfm. will move 7½ tons/hr. of 32-lb./cu. ft. granular products over distances up to 150 ft.

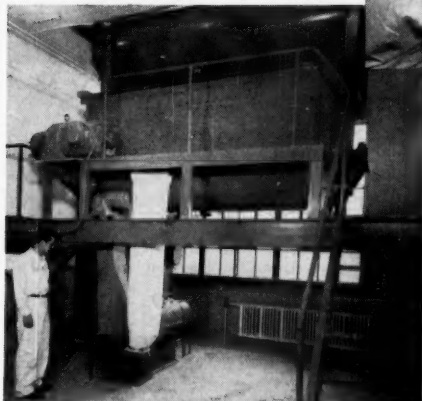
Because products move in an

**TURBULIZER®**

**provides  
homogeneous mix  
... saves time,  
money and  
space**

Smooth machined surfaces within the Strong-Scott Turbulizer leave no place for material to gather on the walls. Also, the high centrifugal action within prevents material from accumulating on the shaft or paddles. Sanitary, quick disconnect seals on each end of the shaft prevent foreign material from contaminating mix.

Installing a Strong-Scott Turbulizer not only resulted in getting a better, more uniform mix, it also saved considerable floor space formerly occupied by bulky sifting and conveying equipment at DCA Food Industries, Hillsdale, Mich.



The Strong-Scott Turbulizer is used for many different continuous mixing operations in the chemical and food industries. Consult Strong-Scott as to how the Turbulizer can solve your mixing problems.

**DCA FOOD INDUSTRIES OF HILLSDALE, MICHIGAN**, has modernized and simplified their method of acquiring a thorough and homogeneous mixture of shortening in its line of prepared mixes with the installation of the Strong-Scott Turbulizer.

"Our mixes pass successively through three ribbon blenders," states J. R. Travis, Manufacturing Industrial Engineer of DCA Food Industries, "and then into a high speed Turbulizer. Here, the remaining balls of shortening are completely disintegrated into the rest of the dry ingredients by powerful impact action."

When temperature control is desired, a jacket is incorporated on the Turbulizer. Coolant can also be circulated through the shaft. Adjustable paddles are set to close tolerances and the interior is machined to a perfectly smooth bore.

"Another advantage of the Strong-Scott Turbulizer," added Jim, "is the ease of cleaning. Formerly it took two men four hours to clean our sifters and accessory equipment, now the job is accomplished in a fraction of the time as the Turbulizer is almost self-cleaning."

EQUIPMENT DESIGNED FOR  
BETTER PROCESSING

PLAN **59** Modernize now for growth and profits

The **Strong Scott** Mfg. Co.

451 Taft Street N. E., Minneapolis 13, Minnesota

® TURBULIZER is a registered trade-mark of The Strong-Scott Mfg. Co., Minneapolis.

almost-solid phase through the conveying line, with very little entrained air (solids: air = 800:1 by weight), material velocities are low enough to permit use of flexible polyethylene as the line's material of construction. Company officials also claim that the low air requirements eliminate any need for costly separators or dust collectors at the exit end of the line.

► **One Commercial Unit**—Dens-Flo pumps are expected to find wide application in the food industry, especially to operations involving the handling of bulk flour. They can also solve many other problems involving the intra-plant transfer of materials such as low-density chemicals, cement and dry clays. Completely portable and occupying only 37 x 25 in. of floor space, the systems could likewise prove quite valuable at transportation terminals for low-attribution transfer of bin-stored products to bulk hauling equipment.

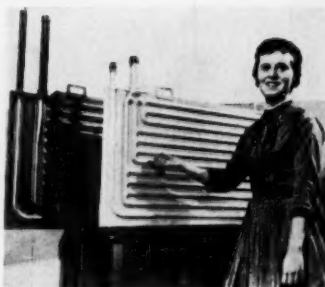
Thus far, only one unit is in commercial operation. The Seattle, Wash. plant of Calite, Inc. is using a Dens-Flo pump to handle wood flour and melamine resin in the manufacture of furniture. Informed sources say that the unit is working quite well.

► **Cost Considerations**—Dens-Flo pumps have a price tag of about \$3,000. As yet, complete costs for operation and maintenance are unavailable, but they are believed to be quite low.

In addition to the required compressed air, the system's only power source is a 3-hp. motor. Officially, horsepower requirement is quoted as  $\frac{1}{2}$  hp./ (ton) (hr.). This figure is based on an assumed product density of 32 lb./cu. ft.

Critical wearing component is the nylon tube for the feeding mechanism. Actual tests showed that this \$50 part lasts about six months when operated 8 hr. each day. Replacement takes about 30 min.

Material of construction for Dens-Flo's other components is either aluminum or steel.—**Granu-Flow Systems, Ltd., Seattle, Wash.** 102A



### Heat Transfer Unit

For industrial heating or cooling applications.

As shown in the above picture (foreground), the new Multi-Zone Platecoil heat transfer unit is, in effect, three units. The steam inlet branches into passages that carry steam directly to all parts of the surface, thus providing even distribution of heat. Similarly, the condensate return is branched to minimize condensate blocking of lower passages. An old Platecoil is also shown (rear) for comparison.

Operating pressures of the new unit go up to 250 psi., with a 5:1 safety factor. Standard sizes range up to 22½ in. wide and 143 in. long. Available in a wide variety of metals.—**Tranter Mfg., Inc., Lansing, Mich.** 104A



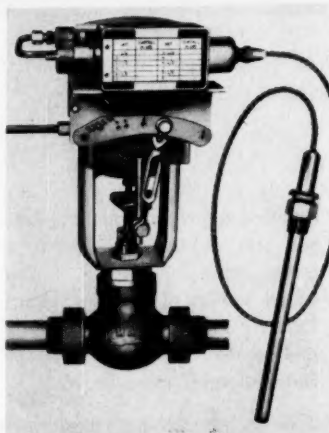
### Gas Chromatograph

Monitors oxidizable gases in process streams.

At 1-min. intervals, a new gas chromatograph withdraws measured samples from any gas stream; the samples pass through the monitor column; and a continuous recorder makes permanent notation of analyses results. Instrument design assures detection of hy-

drogen and methane in concentrations as low as 5 ppm.

If need for a more thorough analysis becomes evident, manual operation of a sampling valve extracts another measured portion of the same stream without interrupting the monitoring function. This sample is then analyzed in a longer column that separates and records through  $C_2$  in about 2 min.—**Precision Scientific Development Co., Chicago, Ill.** 104B



### Control Instrument

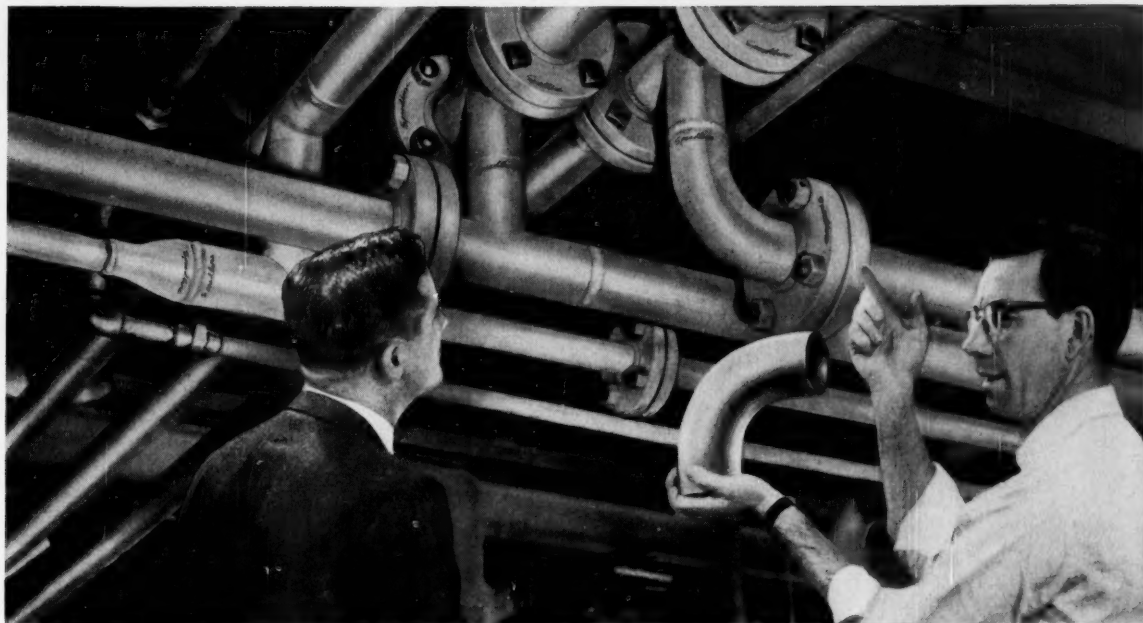
Several functions performed by one device.

A new compact instrument for controlling process pressures or temperatures is claimed to offer unusual flexibility of application, as well as more sensitive, accurate control. In a single package, the Fultro-Matic combines a measuring element, controller, positioner and valve.

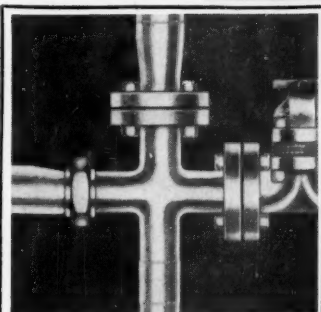
Fultro-Matic, which is pneumatically operated, also claims the advantages of a smaller sensing element that gives rapid response, an adjustable proportional band and a simple, but rugged design that assures minimum maintenance.

Available for ½- to 4-in. lines, the new instrument is also adaptable to use with various pneumatic transmitters. Another version substitutes a lever operator for the control valve.—**Fulton Sylphon Div., Robertshaw-Fulton Controls Co., Knoxville, Tenn.** 104C





## **SPEEDLINE'S EXTRA LENGTH FEATURE GAVE US MORE PIPE PER FITTING DOLLAR**



Flange where you want to, weld where you want to... any type joint can be used with any Speedline fitting. The longer straight section provides ample clearance that simplifies installation and permits easier hook-up of valves, flanges, etc., even in confined areas. The extra length feature is common to all Speedline Ells, Tees, Crosses, Reducers and Bends.

SEE DISTRIBUTOR LISTING PAGE 593 IN  
CHEMICAL ENGINEERING CATALOG.

Extra length on *every* end of *every* Speedline corrosion resistant fitting adds up to *real* savings in pipe costs, compared to systems using conventional fittings (see table).

Time and labor costs are also reduced from preliminary design to finished installation. Design detailing is minimized because any type joint can be used on any—or *all*—ends of a Speedline fitting. Speedline's longer length gives more clearance for welding and faster, *easier* pipe aligning... permits flanging *without* welding by a simple rolling-in operation! And because Speedline fittings are specially designed for use with low cost, light wall stainless pipe, material costs are substantially lower from the start.

Specify Speedline for your process lines—first in the industry to offer extra length for *greater* economy. Write for *free* catalog.

### **SPEEDLINE'S EXTRA PIPE LENGTH BONUS**

I.P.S. SIZE	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"
90° Elbow	2 1/2"	3"	2 3/4"	2 1/2"	2 1/2"	3"	2 1/2"	4"	4 1/2"
45° Elbow	2 1/2"	3"	2 3/4"	2 1/2"	2 1/2"	3"	2 1/2"	4"	4 1/2"
Tee	4 1/8"	4 1/2"	4 1/8"	3 3/4"	3 3/8"	4 1/2"	4 7/8"	4 7/8"	4 7/8"
Cross	5 1/2"	6"	5 1/2"	5"	4 1/2"	6"	6 1/2"	6 1/2"	6 1/2"

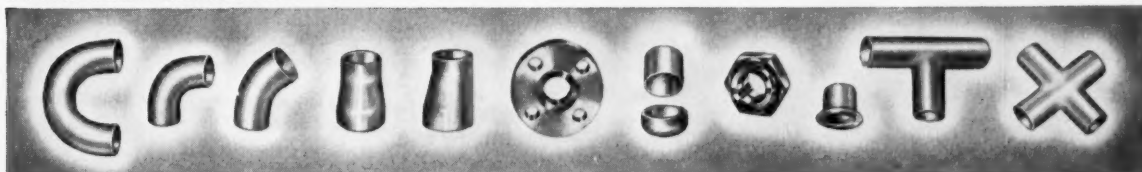
With 100-2" Speedline elbows you get 25' more pipe than with conventional fittings. How do these pipe savings add up for your requirements?

*Speedline*®

® REG. T.M. OF HORACE T. POTTS COMPANY

## **STAINLESS STEEL FITTINGS**

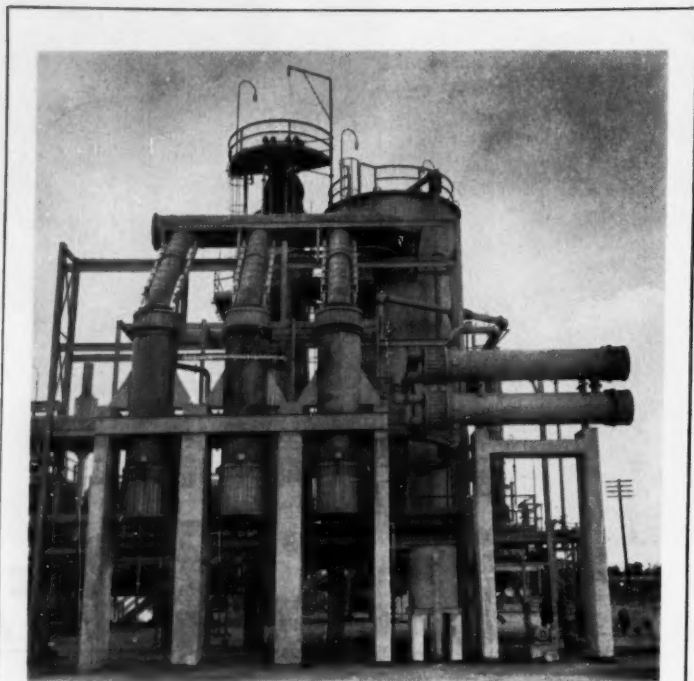
SPECIALLY DESIGNED FOR SCHEDULES 5 AND 10 PIPE



Manufactured by HORACE T. POTTS COMPANY • 500 E. Erie Ave., Philadelphia 34, Pa.

CHEMICAL ENGINEERING—March 9, 1959

105



### Texas-Size Trio of Graphite Heat Exchangers

Three of the biggest Karbate impervious-graphite shell-and-tube heat exchangers ever made are shown above in service at Olin Mathieson Chemical Corp.'s Beaumont, Tex. plant. Used in the recovery of sulfuric acid from petroleum-refining acid

sludge, each of the three units has Texas dimensions in itself. An outer steel shell 45 in. in diameter houses a tube bundle having 685 12-ft.-long tubes—a total heat transfer surface of 2,685 sq. ft./unit.—National Carbon Co., Cleveland, Ohio. 106A

### Rotary Kiln

**New design concepts cut maintenance costs.**

Substitution of spherical roller bearings for conventional bronze bearings is just one of the many improvements incorporated into the manufacturer's new rotary kiln. This change alone will slash maintenance costs—average life of the new kiln's bearings is 500,000 hr., compared to a previous average of about 5,000 hr. The first such unit has just been built and is slated to be put into operation at the plant of Pigmentos de Mexico in Tampico, Mexico.

Another improvement is replacement of the conventional, fixed trunnion rollers by self-aligning rollers. Free to swivel on a greased interface about a fixed pin, the new rollers automatically align themselves with the kiln's axis, thus eliminating wear and need for constant adjustment.

With this type of arrangement, thrust load incident to the kiln's slope is now carried completely by a newly designed separate roller assembly.

Among the other improvements are use of Brinell 245 alloy steel for the rollers and Brinell 215 for the tire, and a Bowser forced-feed lubrication

system for the bearing assembly. — Vulcan Iron Works, Wilkes-Barre, Pa. 106B

### Chemical Slide Rule

**Shows whether reactions are feasible.**

Called the Graphic Chemical Predictor, a handy slide rule of chemistry will actually define whether or not a reaction is possible for each of 10,000 different chemical equations.

Simply spin the plastic dial to the desired equation components. Then add the oxidation and reduction potentials indicated to ascertain whether the reaction is feasible. Each Predictor is 8 in. diameter; price is \$1.95. — Graphic Calculator Co., Chicago, Ill. 106C



### Expendable Pallets

**Low-cost units will end need for pallet deposits.**

Extremely light in construction, a new expendable pallet is expected to revolutionize shipping practices throughout the process industries, according to

**EQUIPMENT  
NEWS**

Continues on... Page 213

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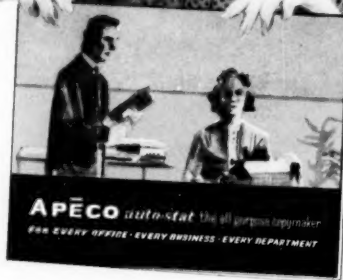
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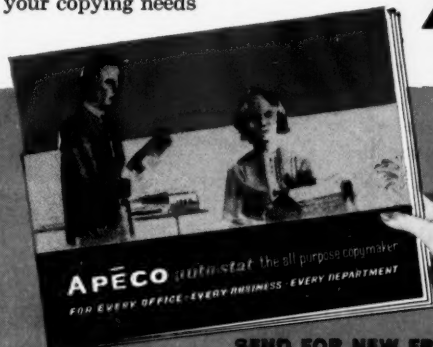
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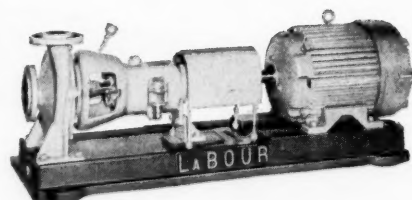
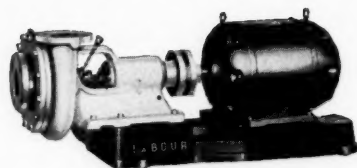
but who drops  
feathers in  
a vacuum?



In a perfect vacuum, a feather is supposed to drop at the same speed as a chunk of lead. Nobody, so far as we know, has actually tried to produce a perfect vacuum in apparatus suitable for such an experiment. In the work-a-day world, the lead beats the feathers to the bottom every time.

There are theories about pump performance, too—sound theories, demonstrable in any laboratory. In the work-a-day world of the chemical plant, however, it's *actual* performance, not theoretical, that earns a profit. And that's where LaBour has been consistently on top for more than 35 years—and still is.

Most pump service per dollar cost—that's the way to measure pump value. If you want to see proof of LaBour superiority on this basis, we'll be delighted to provide it for you. Just drop us a line.



ORIGINAL MANUFACTURERS OF THE SELF PRIMING CENTRIFUGAL PUMP

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MgO

Heard the news about *International* magnesium oxide? Highest purity ever achieved in carload quantities...purity you'd expect to find only in laboratory-controlled samples. And it's in the low price range!

Not to mention wide application. Among its uses: As a stabilizing and vulcanizing agent for rubber...in high-grade ceramic and glass formulations...for acid neutralization, electrical insulation, uranium ore treatment. It has demonstrated its worth in both high-purity magnesium chemicals and in low-sulfate, high-magnesium catalysts. What's more, *International* MgO has proved preferable to magnesite produced by conventional methods. And there's still more to come through *International* research.

A test sample of low-iron, low-lime *International* MgO in any of its three forms—powdered, pelletized or granular—is yours for the request. Please do—today.

#### CHEMICAL SPECIFICATIONS

Chemical		Purity Range
MAGNESIUM OXIDE .....	MgO .....	99.40 — 99.70%
IRON .....	Fe <sub>2</sub> O <sub>3</sub> .....	0.03 — 0.06%
LIME .....	CaO .....	0.07 — 0.08%
ACID INSOL.* .....	.....	0.02 — 0.10%
OXIDES** .....	R <sub>2</sub> O <sub>3</sub> .....	0.04 — 0.09%
BORON .....	B <sub>2</sub> O <sub>3</sub> .....	0.0025 — 0.015%
CHLORIDE .....	Cl .....	0.015 — 0.06%
SULFATE .....	SO <sub>4</sub> .....	0.02 — 0.07%
SODIUM AND POTASSIUM .....	Na-K .....	0.02 — 0.07%
LOSS ON IGNITION .....	.....	Nil

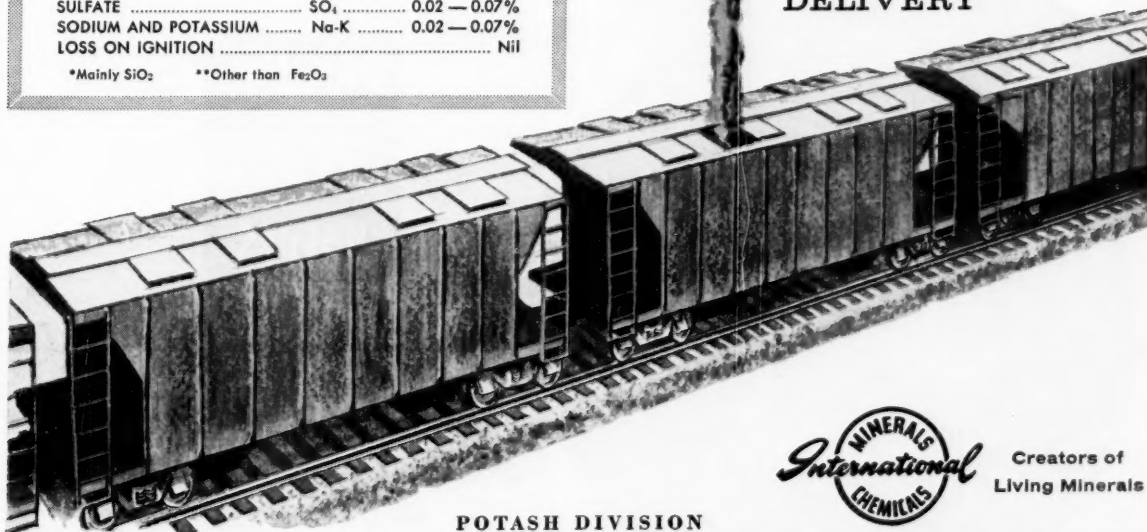
\*Mainly SiO<sub>2</sub>

\*\*Other than Fe<sub>2</sub>O<sub>3</sub>



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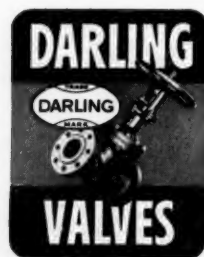


# ALUMINUM GATE VALVES

by Darling

Darling gate valves of aluminum alloy offer all of the unique, extended-life features inherent with the Darling fully revolving double disc, parallel seat principle... for performance that assures unmatched economy... and freedom from leakage, trouble and downtime!

These Darling aluminum alloy valves are now available in  $\frac{1}{2}$ " through 24" sizes. Write for full details, specifying your particular service requirements.



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# WIZARD II

## PRESSURE CONTROLLERS



- Two Position Controller
- Proportional Controller
- Proportional Controller—Remote Set
- Differential Proportional Controller
- Pressure Transmitter
- Differential Proportional Controller—Remote Set
- Proportional Reset Controller
- Differential Proportional Reset

### This "Jack of ALL Trades" is surprisingly low in cost

The partial list of applications at left tells you why the Wizard II is so aptly named. Probably no other controller in the Fisher line is as versatile. Available in brass, steel or stainless steel Bourdon tubes for ranges from 25 to 10,000 psi. Brass or stainless steel bellows available for low pressure service from 30" Hg Vacuum to 30 psi.

Fisher has carefully designed each component of the new Wizard to satisfy the most rigid process control requirements. A completely descriptive and illustrated booklet on the Wizard II is yours for the asking. Write for Bulletin D 4150 A.

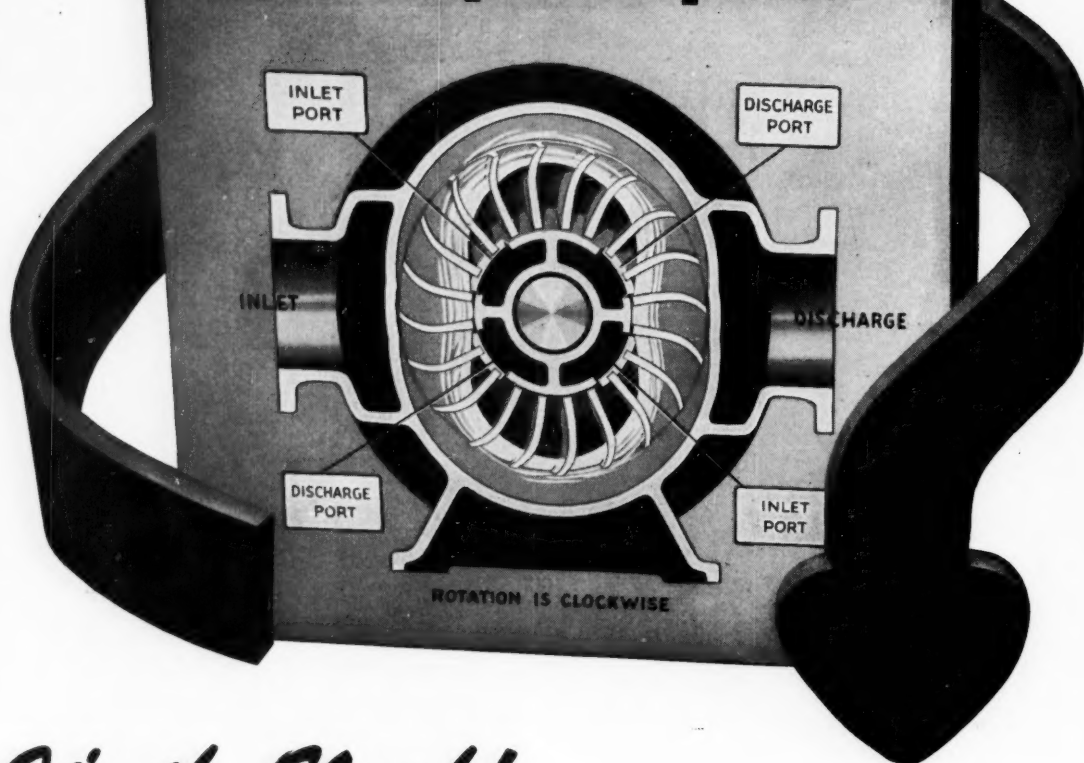


IF IT FLOWS THROUGH PIPE ANYWHERE IN THE WORLD... CHANCES ARE IT'S CONTROLLED BY...

**FISHER GOVERNOR COMPANY**  
Marshalltown, Iowa / Woodstock, Ontario / London, England  
CONTINENTAL EQUIPMENT CO. DIVISION, Coraopolis, Pennsylvania



## This is Why the Nash is the Most Simple Compressor



## *It's the Nash!*

There are no mechanical complications in a Nash Compressor. A single moving element, a round rotor, with shrouded blades, forming a series of buckets, revolves freely in an elliptical casing containing any low viscosity liquid. This liquid, carried with the rotor, follows the elliptical contour of the casing.

The moving liquid therefore recedes from the rotor buckets at the wide part of the ellipse, permitting the buckets to fill with gas from the stationary Inlet Ports. As the casing narrows, the liquid is forced back into the rotor buckets, compressing the gas, and delivering it through the fixed Outlet Ports.

Nash Compressors produce 75 lbs pressure in a single stage, with capacities to 6 million cu. ft. per day in a single structure. Since compression is secured by an entirely different principle, gas pumping problems difficult with ordinary pumps are often handled easily in a Nash.

Nash simplicity means low maintenance cost, with original pump performance constant over long periods. Data on these pumps sent immediately on request.

No internal wearing parts.

No valves, pistons, or vanes.

No internal lubrication.

Low maintenance cost.

Saves floor space.

Desired delivery temperature automatically maintained.

Slugs of liquid entering pump will do no harm.

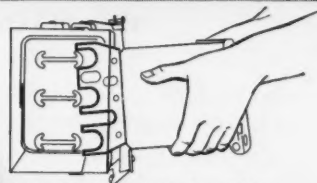
75 pounds in a single stage.

**NASH ENGINEERING COMPANY**  
313 WILSON, SO. NORWALK, CONN.

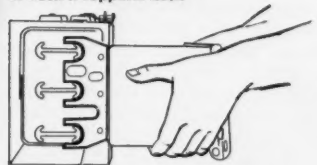
*Another Reason for Using Square D  
Aluminum Plug-in Duct...*

# SQUARE D PLUG-IN UNITS GIVE YOU EXCLUSIVE *hook-swing* MOUNTING

## Safer, Faster, Easier Mounting



Hook clip at top of plug-in unit to top of duct. It supports itself



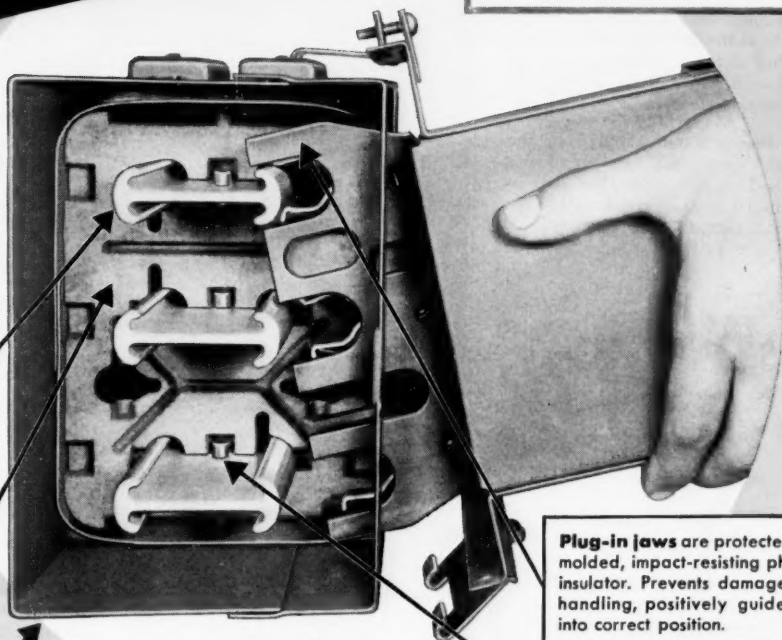
Then, just swing plug-in unit down until jaws engage bus bars

**Hanger mounting** (not shown) makes installation easy. A universal hanger permits mounting in any position. Just suspend and level top portion of hanger, then clip on lower portion. U.L. approved for 10-foot spacing.

**I-beam construction** of bus bars—a Square D exclusive—provides four times the strength of conventional bus bars. Bars are zinc, copper and silver-plated full length.

**Full width bus support** provides greater strength on short circuits, freedom from vibration. Also acts as fire stop where duct passes through walls and floors.

**Square D duct is totally enclosed** for maximum safety—no danger of accidental shorts. Prevents overheating from dust accumulation.



**Plug-in jaws** are protected by a molded, impact-resisting phenolic insulator. Prevents damage from handling, positively guides unit into correct position.

**Steel pins** in each bus bar prevent bars from shifting and support them on vertical riser installations.

With other plug-in duct, it's no easy job to mount the plug-in units. In fact, it takes a lot of real pushing which is neither safe nor easy when you're working on a ladder. With Square D's exclusive *hook-swing* mounting, you just hook the plug-in unit to the top of the duct. Then, simply swing it down and in until the jaws have engaged the bus bars. No awkward

pushing required—no unnecessary chances to take.

Square D aluminum plug-in duct with exclusive *hook-swing* mounting costs no more—why settle for less?

*Write for Bulletin SD-110. It gives the facts on Square D aluminum plug-in duct. Address Square D Company, 6060 Rivard Street, Dept. SA, Detroit 11, Michigan*

**EC&M HEAVY INDUSTRY ELECTRICAL EQUIPMENT...NOW A PART OF THE SQUARE D LINE**



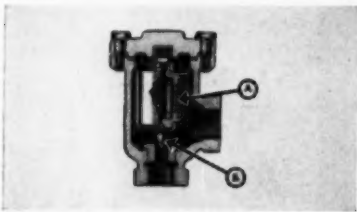
## SQUARE D COMPANY

## Full-range steam traps cut high cost of steam pressure variations

By John W. Ritter, Test Engineer  
SARCO Company, Inc.

While boiler room economics dictate that boiler pressures remain constant, the equally sound economics of batch processing may decree that pressures at the equipment vary with the requirement of the process. The attempt to choose a steam trap that is all things to all conditions may result in installing traps that operate inefficiently at either extreme of their pressure range or that require adjustment every time the operations sheet calls for another pressure-temperature setting. Orifice traps represent a somewhat more rational approach to the problem, but often at the price of a continuous discharge of steam, particularly at the low pressures of start-up and shut down. Compromise, adjustment, and steam waste all spell inefficiency in the utilization of steam.

**Production-Planned** steam trapping, on the other hand, improves efficiency by the use of properly designed and installed thermostatic steam traps. Such traps employ the expansion and contraction of a thermostatic element to operate the discharge valve.

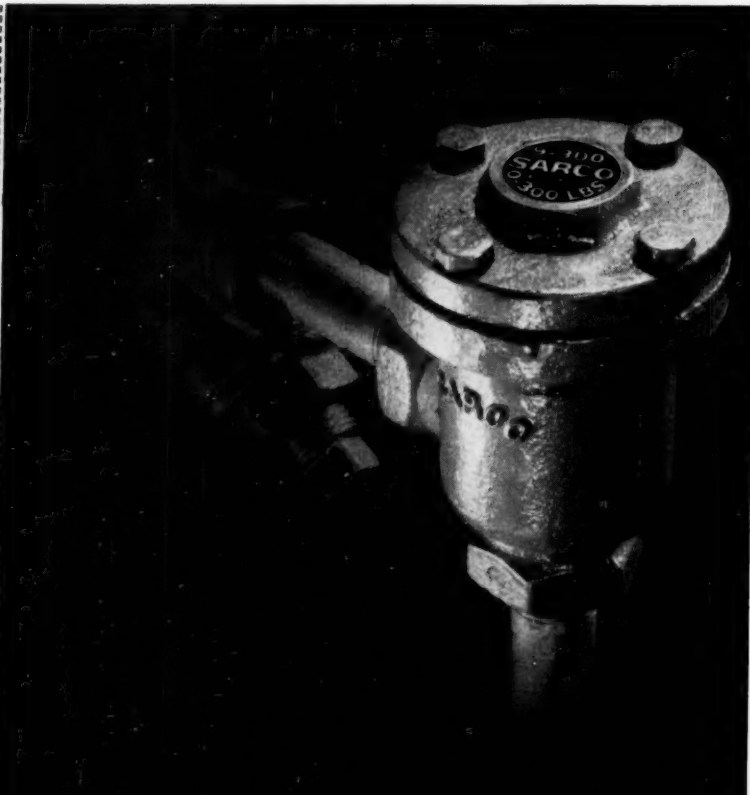


In Sarco Thermostatic Steam Trap, element (A) expands at steam temperature to close valve (B). contracts to permit discharge of condensate.

In the Sarco "Balanced Pressure" Thermostatic Steam Trap a volatile fluid is sealed inside a metal bellows that opens or closes the valve as it contracts or expands with condensate temperature. Near steam temperature, evaporation of the fluid creates an internal pressure greater than steam pressure in the trap body, and the expanding bellows seats the valve. When the condensate cools, the element contracts and opens the valve.

It is evident that at steam temperature pressure inside the element is higher than steam pressure, no matter how the latter may vary. Thus, the trap compensates automatically for variations in pressure.

52108



**Maintenance Crew:**

**This steam trap handles 0-300 psi;  
No adjustment necessary!**

Sarco "Balanced Pressure" Thermostatic Steam Traps cut trap maintenance costs and simplify parts inventory. Why? Because the same bellows, head and seat handle steam pressures up to 300 psi — without any need of adjustment for variations in load or pressure.

Other advantages: unmatched capacity/cost ratio (1" size discharges 9,650 lbs./hr. at 10°F below steam temperature, 125 psi). This trap can't air-bind and, when installed with free discharge, can't freeze.

Long life and reliable performance are assured by an exclusive Sarco process for fabricating the one moving part — the thermostat — and by steam-testing of every single trap at maximum rated pressure.

Write for "Literature Kit 1A" today. And remember, Sarco can give you impartial advice on *Production-Planned* steam trapping because . . .

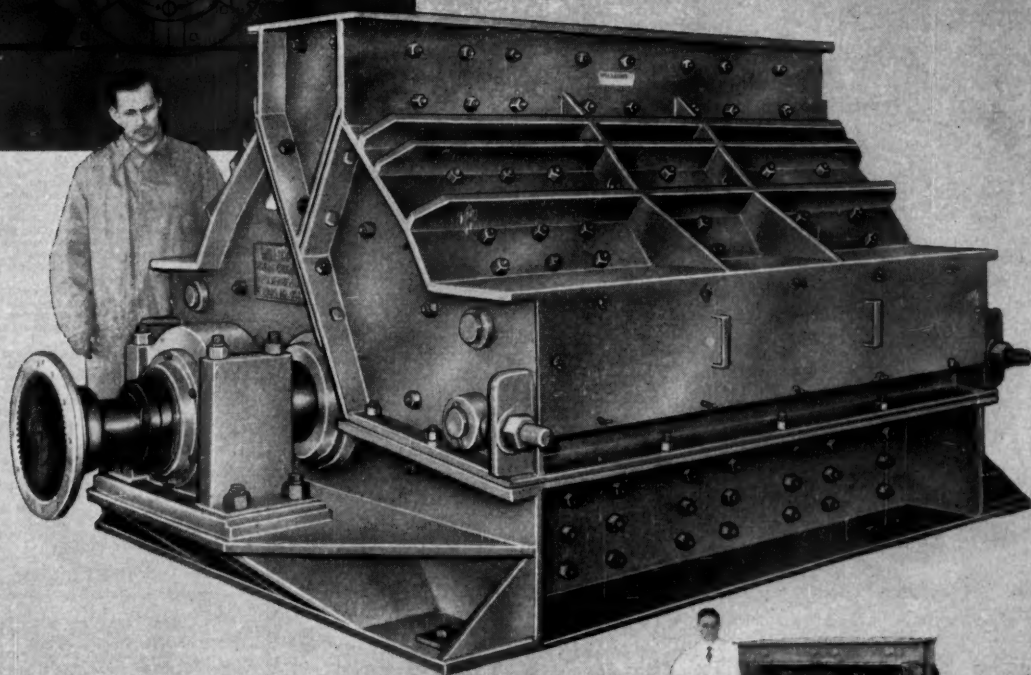
**SARCO COMPANY, INC., 635 MADISON AVENUE  
NEW YORK 22, NEW YORK**

*Only Sarco makes all 5 types:*

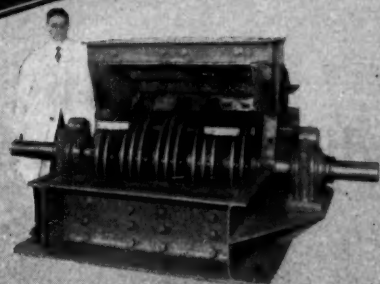
Thermostatic • Liquid Expansion • Float Thermostatic  
Thermo-Dynamic • Bucket



# **WILLIAMS REVERSIBLE IMPACTOR**



- 100% Impact Reduction
- No Friction Or Abrasion
- Unobstructed Discharge
- Less Upkeep Expense



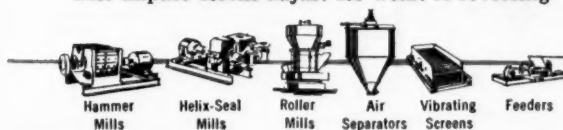
Internal view showing manganese steel impact blocks, hammers and liners. Rugged, heavy steel plate construction. Extra large shafts are mounted in oversize bearings sealed in self-aligning housings.

## **Unequalled For Secondary Grinding**

Reduces limestone and material of similar hardness to  $1\frac{1}{2}$ ",  $\frac{3}{4}$ " or smaller. Properly adjusted, the Williams Impactor makes excellent material with the proper percentage of fines for road base course. Unusually low upkeep expense as reduction is 100% by impact. Material is fed to enter between the hammers and is thrown against the impact blocks setting up a repeated ricochet action which accomplishes the reduction. Adjustable impact blocks adjust for wear. A reversing

switch on motor permits rotating hammers in either direction, to the left today and to the right tomorrow, thereby giving double hammer life. No grates are used. Entire bottom is open permitting unobstructed discharge of crushed material and less wear and tear. A size for every job. Let us tell you about one for your use.

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Oldest and Largest Manufacturers of Hammer Mills in the World





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WHEREVER YOU ARE LOCATED in the United States there is a dependable Sola-Flex representative nearby—ready to give immediate service and technical assistance on your expansion joint needs. This prompt, efficient service is but one of the many reasons why forty of America's fifty largest businesses rely on Sola-Flex expansion joints to help solve difficult piping problems. (Another reason is the outstanding Sola-Flex record of performance and reliability.)

Solar manufactures the most comprehensive line of expansion joints in the world. They are made from a wide variety of stainless and high-temperature alloys in a complete range

of sizes from ½ in. to 35 ft. in diameter. Temperatures range from -320°F to 1200°F, pressures from full vacuum to 600 psi and up. And rugged Sola-Flex expansion joints can be "in service" one to four weeks after receipt of order.

A new pamphlet describes Solar's complete line of Sola-Flex expansion joints. Write for it to Dept. F-130, Solar Aircraft Company, San Diego 12, California.

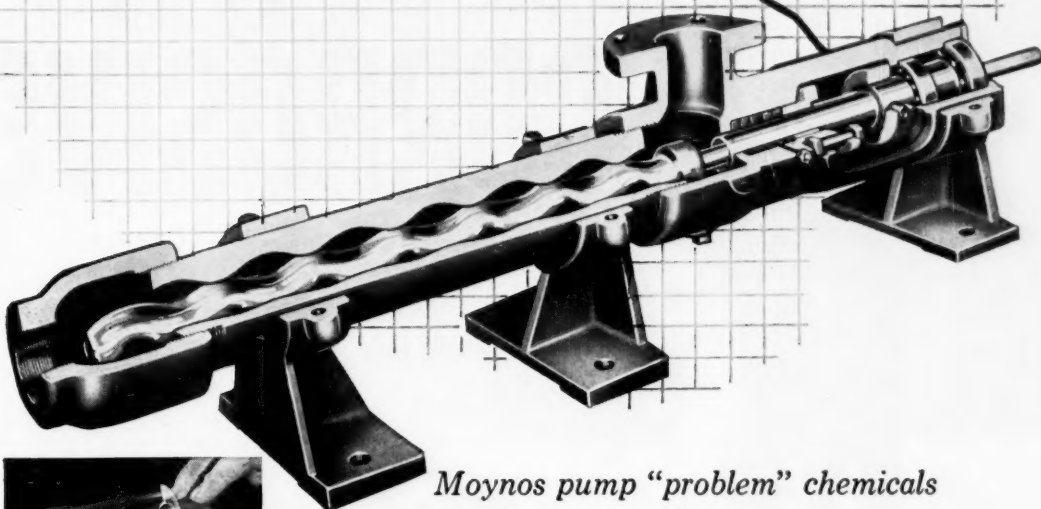


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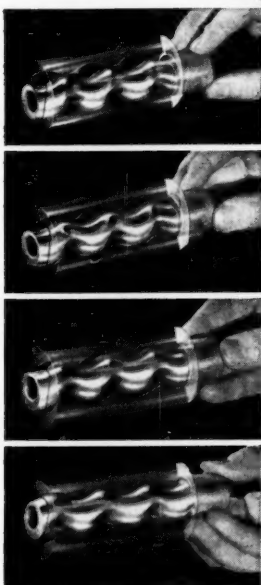
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# MOYNOS<sup>®</sup>

## SLASH PUMP MAINTENANCE COSTS



*Moynos pump "problem" chemicals  
that ruin other pumps!*



**PROGRESSING CAVITY PRINCIPLE**  
A screw-like rotor revolves in a double threaded helical stator creating smoothly moving cavities.

Moyno Pumps have increased production and greatly lowered downtime on many chemical jobs where they replaced other type pumps which had run up prohibitive maintenance costs or failed completely.

Moynos can pump any chemical that can be forced through a pipe, whether a thin watery slurry or an extremely viscous material like rubber dough. A rugged screw-like rotor turning inside a double threaded stator forms "progressing cavities" which move chemicals smoothly. Fluids are pumped without turbulence or agitation. Discharge is uniform, nonpulsating.

Moynos last longer on tough chemical duty because the rotor and stator can be made of special materials that resist the tortures of abrasion and corrosion. Moynos need few or no repair parts . . . show little wear, even after long service.

If you are moving chemicals by hand or other expensive means because they're considered "unpumpable" . . . or if you want to decrease present pumping costs on "problem" chemicals, send us an outline of your problem today. Write for your free Moyno Pump Bulletin 30-CE.



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# **PROCESS FLOW CORROSIVE?**



**Honeywell control valves are available  
in a wide range of materials**



Whether you're talking about corrosive or non-corrosive fluids, there's a Honeywell automatic control valve for your particular process flow. It is available in any castable body material and trim material such as . . . stainless steels, Hastelloy, Monel and Durimet

20. This variety of materials permits economical construction to fit your corrosive process flow application.

For corrosive or non-corrosive flows . . . or other process flow conditions . . . Honeywell valves are available in a wide range of types and sizes. When you need control valves . . . contact your local Honeywell field engineer. Write for new Catalog C800-1.

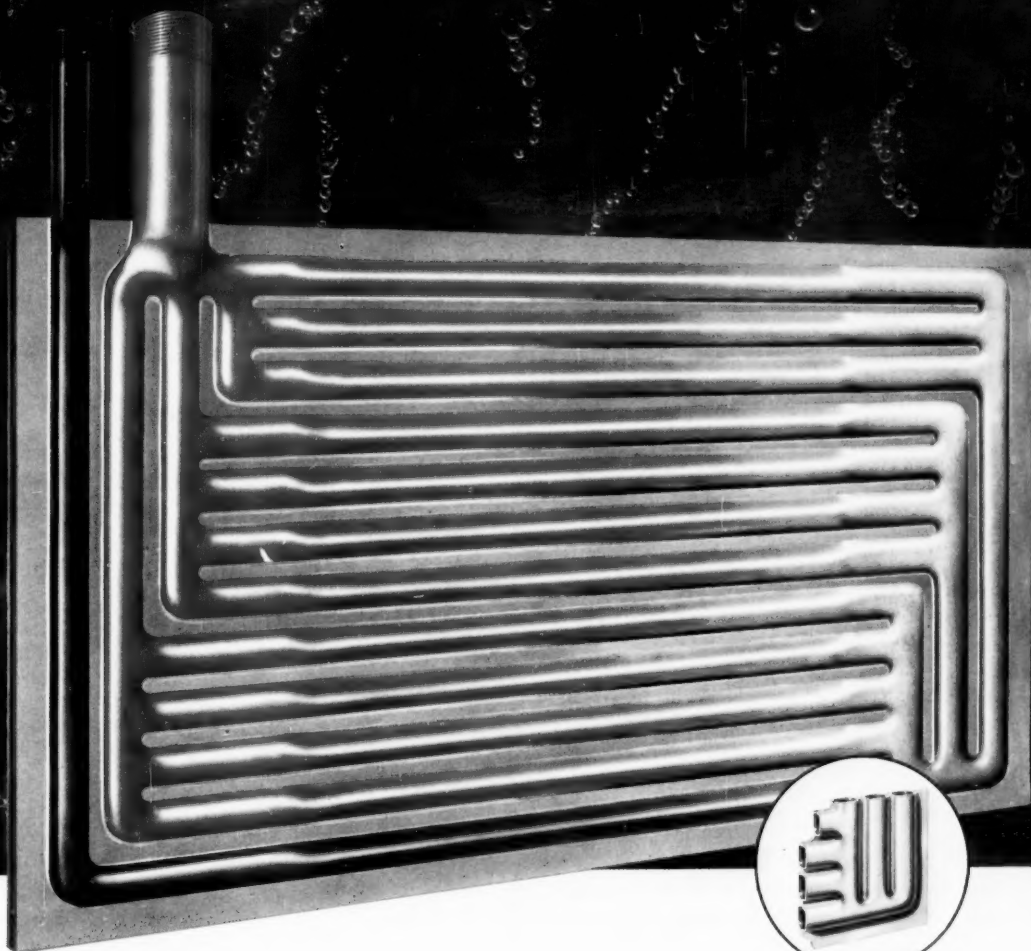
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## **Honeywell**

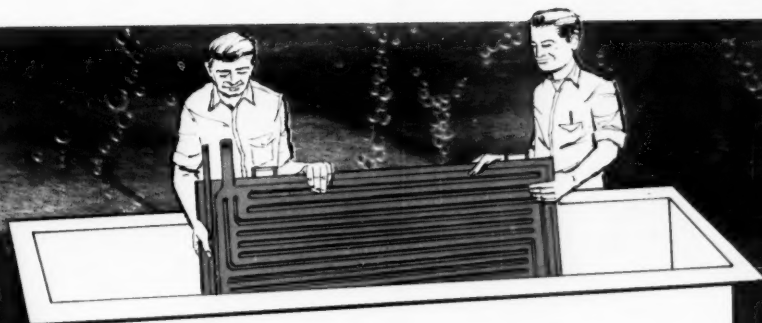


*First in Control*





# NEW MULTI-ZONE PLATECOIL<sup>®</sup>



*An exclusive Tranter advancement  
in heat transfer technology*

\*Patents applied for

**IMPROVED PLATECOIL® design  
cuts "downtime", compensates for  
intermittent overload**

The new MULTI-ZONE PLATECOIL provides a reserve of heating and cooling capacity for faster heat transfer when it is needed. This "stand-by" capacity is available to meet the demands during "start-up" of processing tanks after week-end shut downs. It also supplies the recovery ability needed to keep tanks at a desired temperature as new "work" or processing ingredients are introduced.

MULTI-ZONE coil configuration, a TRANTER exclusive, distributes steam uniformly to all levels of the plate to produce "total effective area" heat transfer. FREE-FLO ACTION, without efficiency-robbing condensate trapping has been accomplished through the use of multiple headers.

In addition to this bonus capacity, the new MULTI-ZONE PLATECOIL presents new construction features which expand application possibilities.

Operating pressures up to 250 psi, with a safety factor of over 5 to 1, enable you to apply the cost-cutting advantages of PLATECOIL to a wider than ever range of heating and cooling problems. Higher pressure containment has been accomplished through the use of TRANSTEEL, mill-controlled mild steel in standard PLATECOIL, plus DURAWELD bonding of plates. TRANSTEEL also holds corrosion to a minimum.

# NOW FASTER START-UP... CONSTANT TEMPERATURES

**Factory-fabricated units cut engineering,  
installation and maintenance costs**

The new MULTI-ZONE PLATECOIL offers the time-proven advantages of PLATECOIL over pipe coils. Higher efficiency saves tank space. Standardized "package" units can be engineered quickly and accurately with readily available performance data. You completely eliminate the cost of cutting and assembling pipe coils. Installation costs are low because PLATECOIL units are lightweight and easy to handle. Pre-engineered, ready-made hangers are designed for fast installation and re-

moval of plates for cleaning. Cleaning is easy due to the streamlined PLATECOIL design, which also tends to retard the build-up of deposits on coil surfaces. Electric-welded and pressure tested, PLATECOIL units have no threaded joints to corrode or leak. Simple connections can be located above the liquid level, free from contamination.

Put this new PLATECOIL to work for you to cut costs on all types of heating and cooling applications.

Send for NEW PLATECOIL Bulletin No. P61 for complete specifications and performance data.



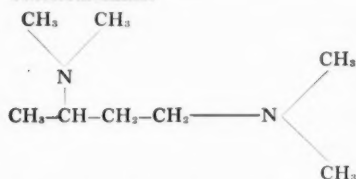
 **Tranter Manufacturing Inc.**  
LANSING 9, MICHIGAN



# Progress Report...

## New chemical for you to explore

Its name is long, so we'll mention it only once: N,N,N',N'-tetramethyl-1,3-butanediamine.



Some of its physical properties are:  
Boiling point, 760 mmHg 165° C.  
Freezing point below -100° C.  
Solubility in water, 20° C. complete

This di-tertiary amine is a colorless, stable liquid, soluble in common organic solvents. It has proved to be a highly active amine catalyst for polyurethane foams, with fast curing rate, and low odor level, producing soft foams.

The new compound should be evaluated as a catalyst for epoxy resins. Its unique structure suggests applications in high energy fuels.

You can get this new chemical from CARBIDE in 55-gallon drums in LCL or carload lots. Technical Information Bulletin F-40392 contains data on physical and physiological properties. For a copy, please check the coupon.

## Double life of propylene glycol

Propylene glycol, well known for its many important industrial applications, is also supplied by CARBIDE as "U.S.P. grade." The high purity of this product is important to formulators of medicinals and certain food products.

Propylene glycol acts as a softening agent, spreader, and emollient for cosmetics and salves. Many perfumes, dyes, and medicinal preparations are improved by the addition of propylene glycol to their formulas. It is often preferred as a hygroscopic agent, especially for maintaining the moisture content of tobacco products.

Colorless, odorless, and tasteless, propylene glycol U.S.P. is fully miscible with water and extensively used

as a solvent, humectant, and preservative. It is ideal for dissolving food flavorings and colorings. In small quantities, it helps packaged foods to retain their freshness and taste appeal.



A full description of properties and useful applications for propylene glycol and CARBIDE's other glycols is found in the 60-page booklet, "Glycols." Get your copy by checking the coupon.

## Gas sweetening with ethanolamines

Natural gas has taken on greatly increased economic value in the past decade because of its rapidly increasing use as a fuel for both home and industry. As natural gases come out of the ground, however, some contain traces of corrosive acid gases such as hydrogen sulfide. Before the gas can be sent through long distance transmission lines, the acid gases must be removed.

Monoethanolamine reacts with weak acids such as hydrogen sulfide and carbonic acid to form unstable compounds. These decompose when heated, liberating the acid gases and freeing the monoethanolamine for reuse. This provides an economic, continuous process for removing these undesirable materials from the gas stream. Because of this, substantially all gas sweetening in the United States is accomplished by the ethanolamines.

In some plants, monoethanolamine is used along with diethylene glycol for simultaneous desulfurization and dehydration. Besides lowering the hydrogen sulfide content, this mixture also removes water vapor which might form hydrates and thus block transmission lines.

Because Union Carbide Chemicals Company has long supplied monoethanolamine to the natural gas industry, we are continually engaged in extensive research activities designed to improve gas treating processes. The results of this research are readily available to the industry through CARBIDE's Technical Service Department. As a part of the service, a comprehensive bibliography of articles devoted to improving gas sweetening operations is available. Compiled by CARBIDE, this publication lists all major articles that have been published on gas sweetening and dehydration over a 25-year period. For a copy, check the coupon.

**Tear out this coupon.** Check the boxes on which you'd like more information, and mail to Dept. H, Union Carbide Chemicals Company, 30 East 42nd Street, New York 17, N. Y.  
☐ Bulletin F-40392. ☐ Glycols.  
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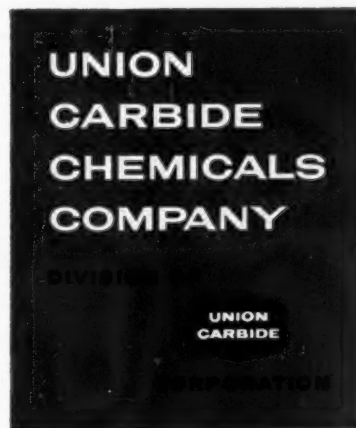
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And remember, there is a CARBIDE sales office near you where you can obtain the services of a CARBIDE Technical Representative. His wide industry experience is backed both by extensive chemical training and by Technical Specialists.

"Union Carbide" is a registered trademark of Union Carbide Corporation.



DEVELOPMENTS ...

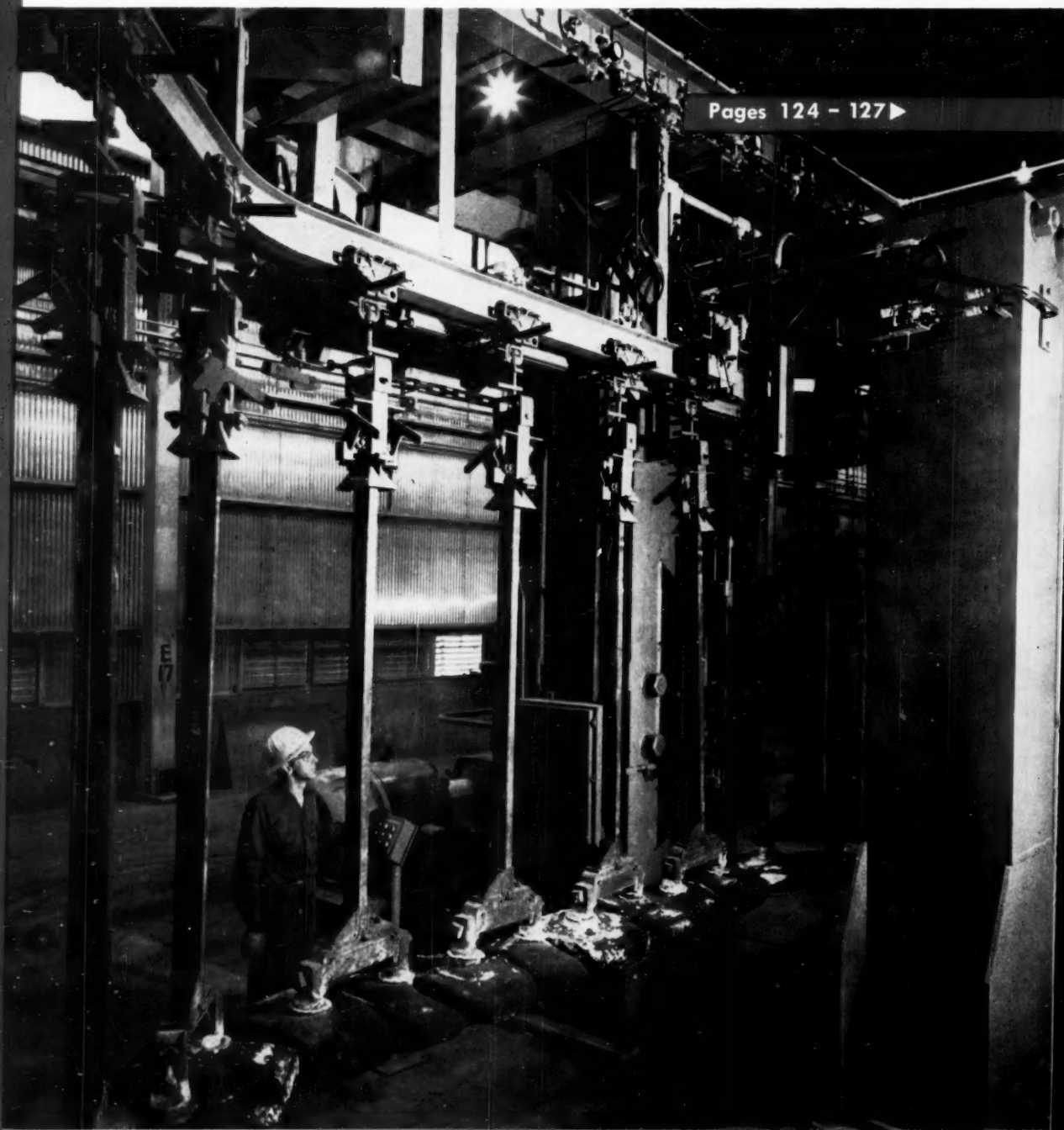
## PROCESS FLOWSHEET

C. S. CRONAN

### Automation Comes to the Aluminum Industry

Kaiser Aluminum brings a new look to the industry with its automatic system for fabricating and rodding the carbon anodes for its reduction cells.

Pages 124 - 127 ►





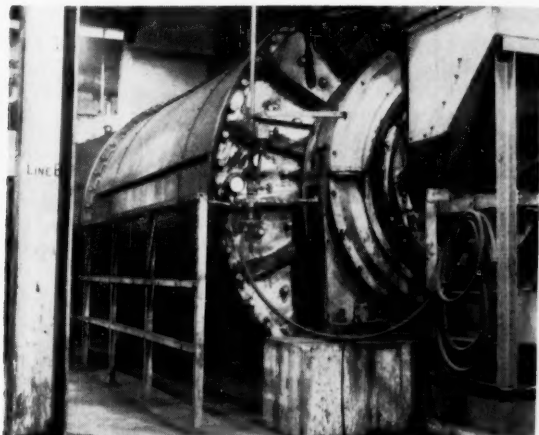
VISITORS touring Kaiser Aluminum & Chemical's huge new \$200-million reduction and fabrication facility at Ravenswood, W. Va., find a technical paradox which characterizes the entire U. S. aluminum industry. Kaiser is pioneering unique automation techniques to supply the reduction pots with a steady and economical supply of prebaked carbon anodes. But aluminum reduction at Ravenswood—and in all the industry—still rests on the 70-year-old Hall-Heroult process which depends on skilled operators.

Kaiser's Ravenswood Works, which poured its first aluminum in November 1957, now has two potlines (164 pots per line) in operation and two more nearing completion bringing capacity to 145,000 tons/yr. primary aluminum. The plant has space reserved for additional potlines.

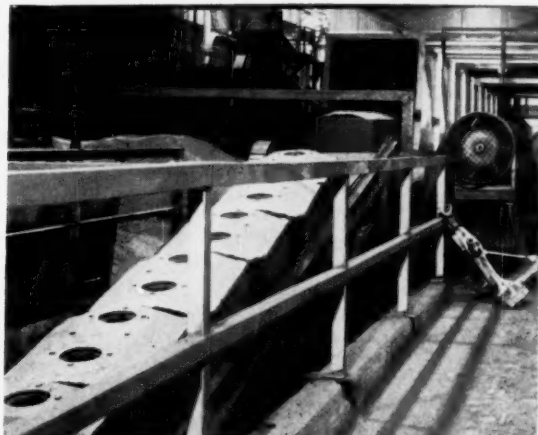
Located on a 3,000-acre site on the Ohio River, Kaiser was the first aluminum reduction facility to locate in the area: Ormet recently brought its plant on stream near Clarrington, Ohio (*Chem. Eng.*, July 14, 1958, p. 86). Growing popularity of the Ohio Valley stems from two factors: (1) 70% of the markets for aluminum lie within a 500-mile radius, (2) Economical electricity generated by coal-fired steam plants using coal from nearby mines.

► **Old and New**—Basis for all aluminum production is the Hall-Heroult process for electrolytic reduction of alumina ( $\text{Al}_2\text{O}_3$ ) dissolved in cryolite ( $\text{Na}_3\text{AlF}_6$ ) using carbon electrodes. Over-all reaction:

$\text{Al}_2\text{O}_3 + 2 \text{C} \longrightarrow 2 \text{Al} + \text{CO}_2 + \text{CO}$   
Gas evolved at the anode contains roughly 70%



**1** BALL MILL grinds the calcined petroleum coke which is mixed with binder and pressed into anodes.



**2** TUNNEL COOLER cools the pressed anode blocks to toughen them for stacking in baking ovens.

◀ **CONVEYOR** takes spent anodes from the pots back to rodding room where rods are fitted to new anodes.



**5** REDUCTION POTS hold 20 carbon anodes apiece. Molten aluminum is tapped into the vessel on the right and sent to casting room.

CO., with CO the principal minor constituent.

The new look in Kaiser's reduction operation is in the pot design. Ravenswood pots feature prebaked carbon anodes with particular emphasis on electrical efficiency. Other cell design found in the industry is the Soderberg\* pot which Kaiser uses, for example, at its Chalmette, La., reduction works.

Industry has changed its thinking from year to year on which type of pot is most economical: Prebaked anode pots get better electrical efficiency, but require anode fabricating and rodding facilities which Soderbergs don't.

Kaiser made two changes in its new pots compared with older prebake pot designs. First, pot

\* In Soderberg pots, the anode is formed by pouring carbon and binder into top of the pot. Heat from the pot bakes the anode in place.

cavity is larger, measuring 17 ft. by 6 ft. by 21 in. deep. And each of the 20 anodes per pot are bigger—weighing 400 lb. each. Larger blocks make cell easier to operate and adjust.

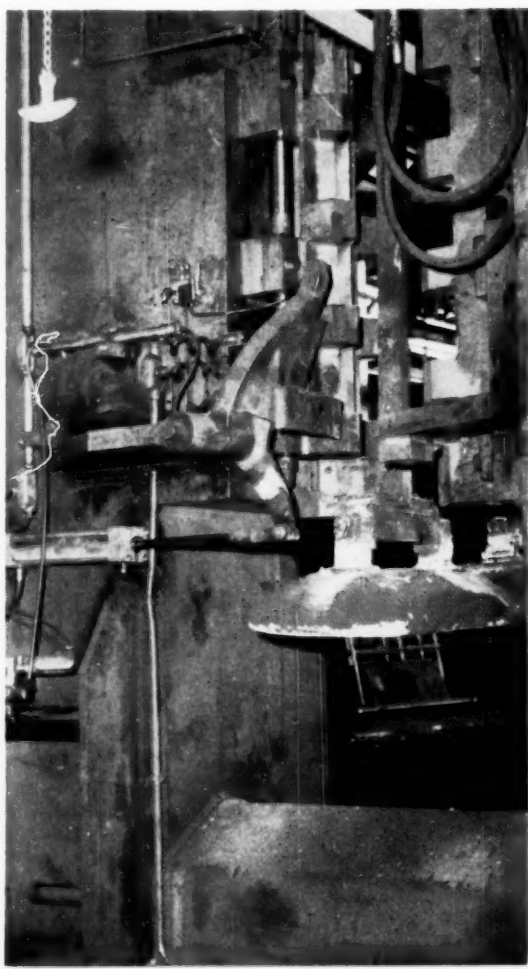
► **Start With Coke**—To make the carbon anodes, calcined petroleum coke (see *Chem. Eng.*, June 30, 1958, pp. 54-56) is taken from storage silos, ground and sized into coarse, medium and fine fractions.

Portions of each grade of coke are automatically weighed into a steam-jacketed batch blender along with hard coal-tar pitch that serves as a binder. (Carbon paste for cathode linings is mixed in a similar fashion, but uses sized anthracite coal and low-melting-point pitch.)

Anode carbon paste, looking like bituminous road-paving material, is conveyed at 250 F. from



**3** INDEXING CONVEYOR automatically fits cleaned copper rods into holes in top of the anode blocks.



**4** BUTT CRUSHER knocks the carbon remnant off spent anodes; rods are then straightened and reused.

the mixer to the feed hopper of a 2,500-ton Elmes hydraulic press.

► **Form and Bake**—After pressing, green anode blocks at 248 F. cool in a tunnel conveyor to make them tough enough to handle and are then stacked in gas-fired baking pits at 2,000 F. Total baking cycle, including cooling, takes 12 days.

A baked anode block is 20 in. wide, 31 in. long 12 in. high and weighs about 400 lb.

► **Enter Automation**—Before the anode blocks can be mounted in the reduction pots, they must have copper connecting rods attached. Kaiser's rodding room is the most highly automated section of the plant.

Baked anode blocks line up end-to-end automatically on the indexing conveyor—heart of the rodding operation. Overhead, suspended from a trolley conveyor, are the copper connecting rods. As blocks and rods progress down the line, the rods are dropped down and steel connecting stubs automatically fitted into holes in the top of the blocks. Molten iron is poured into the cavity around the connecting stub to anchor the rod to the block.

About 700 such assemblies are needed every day to keep two potlines going.

► **Reclaiming Carbon**—Spent anodes from the reduction pots are sent back to the rodding room where remaining carbon (30% of the original block) is knocked off. Cleaned copper rods are sent via a trolley conveyor back to the indexing conveyor while recovered carbon chunks are ground and mixed with incoming calcined coke in the carbon plant.

All operations involving spent anodes and re-rodding are performed on conveyors; assemblies are not handled manually from the time the spent unit leaves the reduction cell until it is returned refurbished.

► **Inside the Pots**—Reduction pots contain 20 prebaked anodes which are continually being replaced as they are consumed.

When operating, the pot has a 5-in. molten aluminum "pad" on the bottom with an 8-in. "bath" floating on top. Bath averages 87% cryolite, 4% dissolved alumina and 9% fluorospar. (Fluorospar lowers cryolite's melting point to a workable range.) A 200-lb. alumina charge is fed to alternate ends of the pot every two hours.

Each potline circuit (with 164 pots in series) is 80,000 amp. at 780 volts d.c.; voltage drop per pot is 4.5 v. at the 1,760 F. operating level.

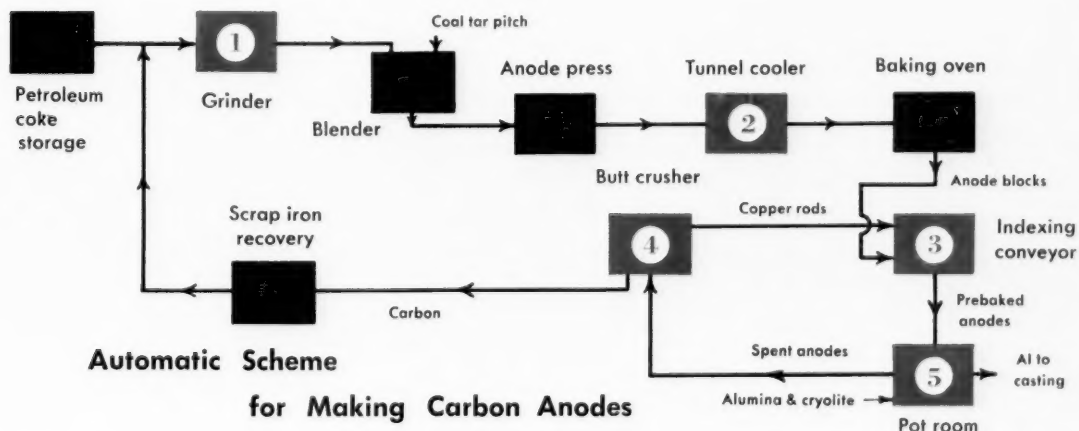
► **Tapping**—When the aluminum pad builds up to around 6 in. (once every 24 hr.), the pot is tapped. A metal siphon, about 6 in. dia., is inserted, a vacuum applied, and 1,200 lb. of molten aluminum siphoned into an 8,000-lb. capacity crucible lined with refractory brick.

Molten metal is shuttled in a transfer truck to the casting and rolling operations.

► **Good Housekeeping**—Cleanliness is stressed in the Ravenswood plant, the reasoning being that a clean plant makes a pure product. Result of this program is startlingly clear in the potrooms where a visitor can see easily from one end to the other. Most potrooms in the industry are half-obscured in a white haze of alumina dust.

Major credit for this clean atmosphere goes to the dust collection system: Hoods over each pot collect 98% of the dust and gases that would otherwise go into the room. Each hood connects to the central duct system leading to a battery of multiclones for alumina recovery. Dust-free gas vents through the 613-ft. stack.

Multiclones recover 60 lb. of solids per pot each day, analyzing 60% alumina, 30% bath and 10% carbon. Recovered solids are fed to the alumina silos and returned to the process.

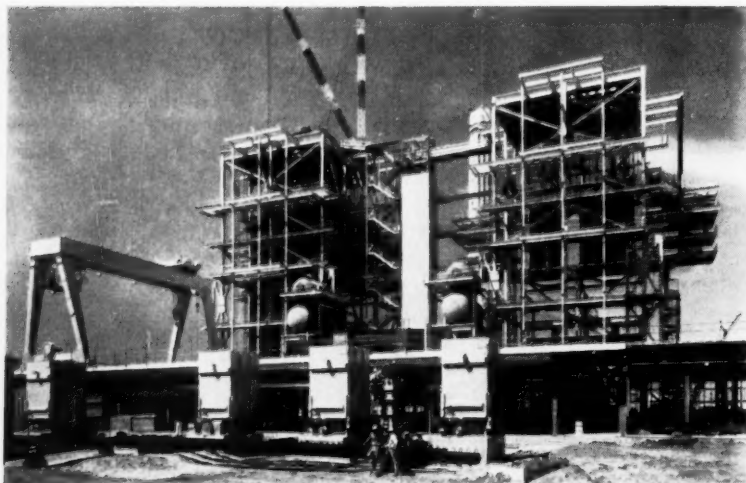


# FRESH WATER NEWS

from Cleaver-Brooks Special Products, Inc.

CAPSULE REPORTS AND INFORMATION ON THE  
PRODUCTION OF FRESH WATER FROM THE SEA

## Pilot plant in California may open new era in salt-to-fresh water conversion



### NEW CONSTANT CAPACITY EVAPORATOR CAPTURES WASTE DIESEL HEAT TO SUPPLY FRESH WATER FOR OFF-SHORE RIGS

A new high-capacity waste heat evaporator for off-shore drilling rigs and tenders has been developed by Cleaver-Brooks Special Products, Inc.

Operating from waste heat of generator-driving diesels, the new flash type unit manufactures fresh water from sea water at constant output. And output is independent of drilling operations.

Costs are kept low due to conservation of fuel and unusually low main-

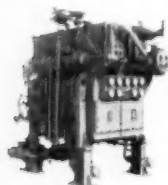
tenance requirements.

The heat required for evaporation is derived from the diesel engine cooling water. The flashing principle utilized by the new unit eliminates scaling problems common with conventional evaporators. Maintenance usually involves only simple brush-out after prolonged periods of operation.

As installed, the unit can provide pure water for drinking, drilling, make-up, bathing and cooking.

### ENGINEERS EXPLAIN HOW NEW METHODS, MATERIALS CUT COSTS, REDUCE UNIT SIZE

According to Cleaver-Brooks engineers, savings of 30% on unit volume and 20% on unit costs are possible through new design and construction of the company's evaporation and distillation equipment.



For example, the deck space needed for a 12,000 gpd flash

evaporator has been reduced from 70 sq. ft. to 55 sq. ft., height cut by 12%.

On the cost side, improved design using equally reliable but lower-cost materials and improved manufacturing techniques—resulted in cost cuts of 20% on one model.

Today, Cleaver-Brooks flash evaporators get one-eighth grain of sea salts per gallon of sea water rather than the usual residue of one-fourth grain per gallon—a 50% improvement in effectiveness.

In a contract recently awarded to Cleaver-Brooks Special Products, Inc., the Southern California Edison Company embarked on a far-reaching program for conversion of sea water to fresh water. The contract calls for construction of a sea water distillation plant with a capacity of about 100,000 gallons a day. It will be operated in conjunction with existing steam generating facilities at the Mandalay Steam Station near Oxnard, Calif. The operation will be the first of its kind in the country.

In awarding the contract, Southern California Edison revealed that Cleaver-Brooks Special Products had made its bid on an evaporator based on a new principle which greatly reduces required heat transfer surface and pumping power. The new unit can be used for both distillation through use of residual heat in cooling water and for distillation using steam extracted from the turbine.

Success of the pilot plant will signal a significant step forward toward the tapping of ocean water for use in home, industry and agriculture. However, Edison officials caution that at this time the water produced by the pilot plant is not expected to compete in cost with fresh water from natural present sources. The hope is that similar installations will eventually be advantageous to use in areas where current water costs are high.

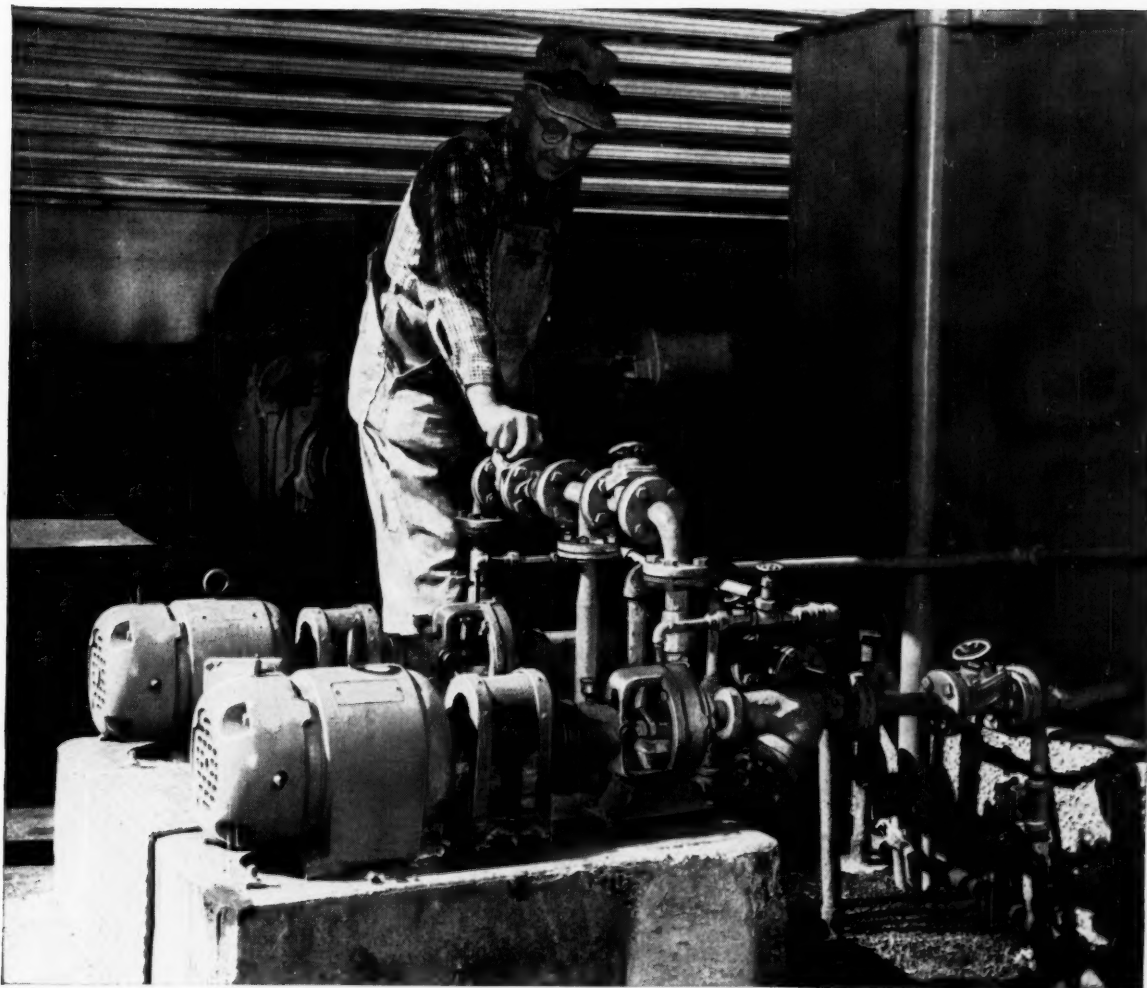
Upon completion of construction, Cleaver-Brooks engineers, who worked with Edison in designing the job, will continue to cooperate in its operation.

**Cleaver-Brooks  
Special Products, Inc.**

225 Grand Avenue, Waukesha, Wis.



## How to cut costs with Crane valves



### 30,660 operations on tough corrosive— and not a penny for maintenance

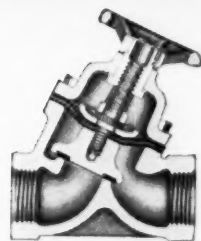
This case history may give you an idea how to save money in your own plant.

The man above is operating Crane 1-inch diaphragm valves on lines to a railroad car washer, used by the Santa Fe Railroad in its Los Angeles yards.

These are Crane No. 1631 valves with neoprene diaphragm and disc insert, and with 18-8 SMO bodies. Handling an acidic cleaning solution, these valves have been operated 12 times a day, 365 days a year

for over 7 years. Yet despite the corrosive fluid, despite the long period of frequent operation, none of these Crane valves has leaked . . . none has had a diaphragm rupture . . . none has required a penny's worth of maintenance.

This is another example of how Crane research and product design help industry avoid costly valve maintenance. For information on any valve application, call in your Crane Representative.



**Cross section—Crane Diaphragm Valve—Screwed Ends.** Note diaphragm seals the bonnet only, separate from disc function. It is not subject to severe flexing, crushing and abrasion as in valves where diaphragm does both jobs: sealing the bonnet and shutting off flow.

## CRANE® VALVES & FITTINGS

PIPE • PLUMBING • HEATING • AIR CONDITIONING

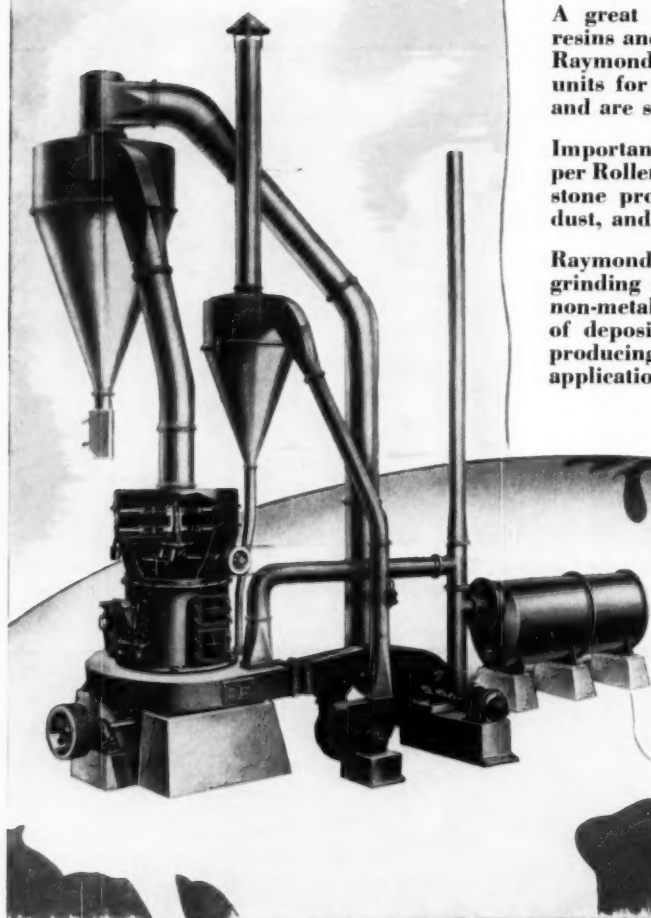
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CHEMICAL ENGINEERING—March 9, 1959

# RAYMOND

# ROLLER MILLS

**In World-Wide Use  
for Half a Century**



THE standardized use of Raymond Roller Mills in so many industries comes as a natural result of these advantages:

1. Ability to pulverize an extremely wide range of products and to handle various types of raw materials from mines, pits, quarries and bed deposits in all parts of the world.
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Process engineer at Sun Oil Refinery examining temperature measurements from "Ceramo" thermocouples.

## Ceramo® Thermocouples Help Sun Oil Prevent Furnace Tube Failure

### Thermo Electric's Versatile "Ceramo" Solves Another Problem

The Sun Oil Company refinery at Marcus Hook, Pa., found the answer to a difficult problem—preventing tube failure in their process heaters—with T-E's "Ceramo-Couples."

As coking and scaling build up within these tubes, heat transfer is reduced and tube temperatures rise. Unchecked, this condition can eventually result in costly, unscheduled shutdowns and potentially dangerous tube rupture.

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Sun Oil went looking for a better thermocouple. They found it in T-E's "Ceramo"—ceramic insulated conductors encased in overall metal sheathing. Their 3/16" O. D. "Ceramo-Couples" have 20-gage Chromel-Alumel conductors and stainless steel sheathing. Thermocouple life was greatly increased, replacement was cut in half.

Reliable readings from "Ceramo" permitted operation of process heaters at higher temperatures—thereby increasing production. "Ceramo's" ability to be bent on a small radius without shorting or grounding simplified installation. And "Ceramo" flexed with the differential motion between tubes and furnace walls.

Sun Oil now has about 300 "Ceramo-Couples" in use at Marcus Hook in 5 to 32 ft. lengths. During the 5 years "Ceramo" has been in use, Sun Oil has had no furnace tube failure or unscheduled shut-downs from faulty temperature measurement.

If you have problems of high temperature, moisture, abrasion, corrosion or difficult installation, investigate T-E's "Ceramo." Only "Ceramo" has the quality of materials and construction to meet all these needs.

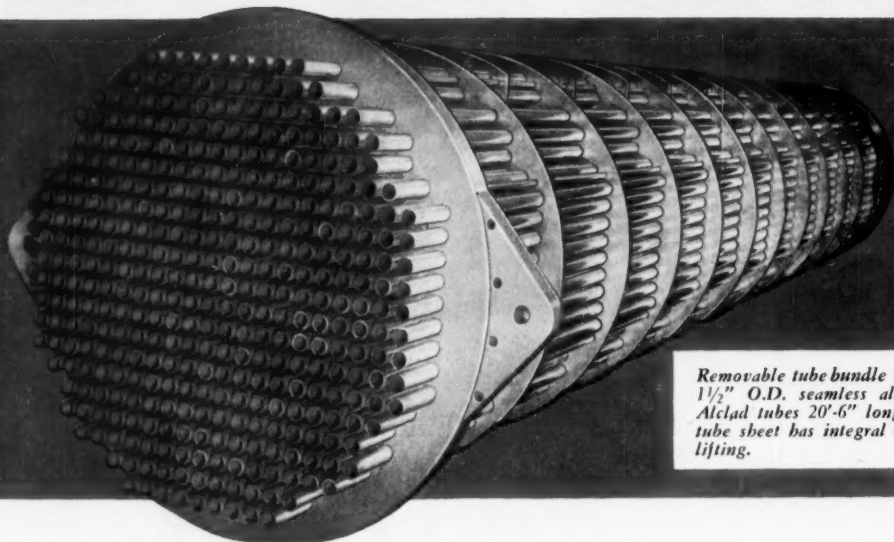
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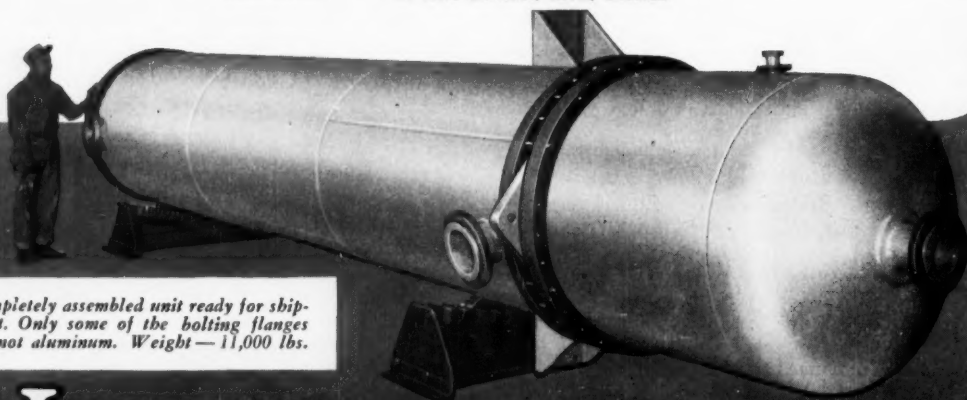


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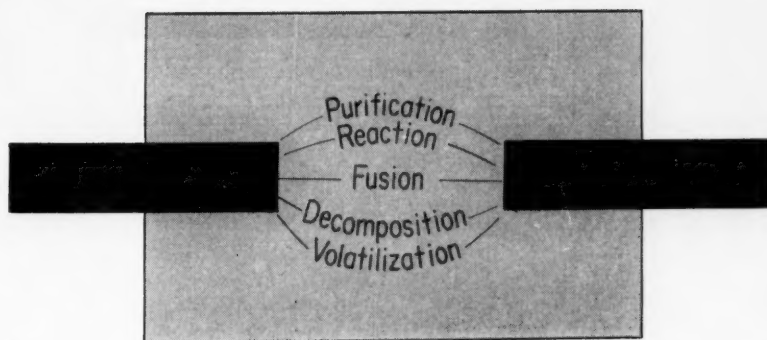
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A Tool for Chemical Processing . . .

## Electric Furnaces

Take a new look at  
the potential of the electric furnace  
as a tool for chemical processing.  
You'll be surprised at the variety of operations  
you can carry out.

**E. D. PORTER**, Supervisor of Technical Services,  
Electro-Chemical Division, Norton Co., Chippawa, Ont., Can.

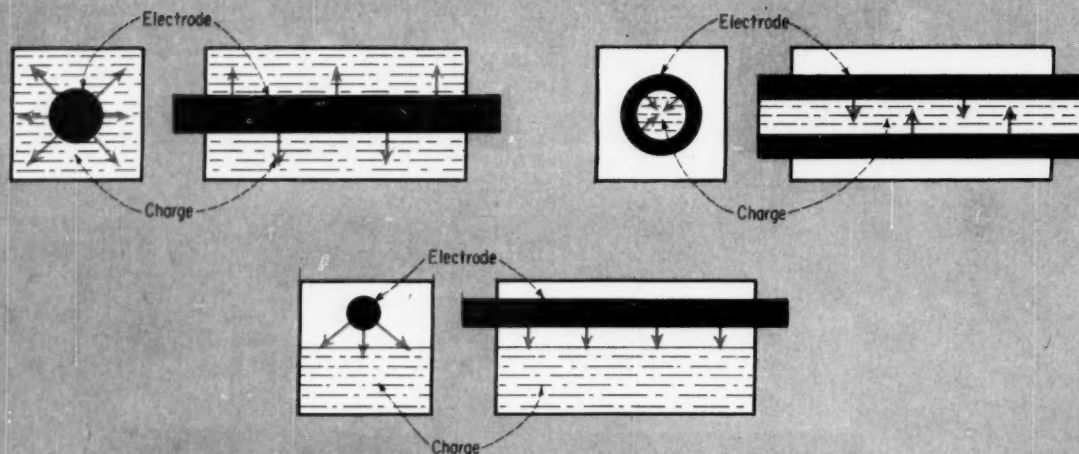
**T**ODAY'S technology has opened a new realm in chemical processing—high temperature. The question is: How do we achieve and make use of these high temperatures? What types of processing equipment are available for production in this high-temperature region?

In its various forms, the electric furnace allows us to apply heat and achieve temperatures well beyond the range attainable from currently available fuels. This, of course, excludes the use of nuclear fuels.

Temperatures of about 2,000 C. are obtainable in gas-fired furnaces, but the physical setup is so complicated and costly that this approach isn't economically competitive with electric heating. Some of the problems involved with high-temperature, fuel-fired furnaces are: suitable refractories, suitable atmospheres and handling great volumes of gas.

Electric furnaces have several advantages, depending on how the energy is applied. In general, they lend themselves to

### Three Varieties of Resistance Furnaces



atmospheric control, are clean and, most important, temperatures beyond 4,000 C. can be achieved.

The technology of applying temperatures of 4,000 C. allows industry to commercially produce many compounds heretofore considered either theoretical or of academic interest. Many new refractory and electrochemical compounds are now available by applying electrical energy.

Availability of these new high-melting compounds in turn makes many high-temperature operations possible. In fact, many laboratories are studying new techniques to raise temperature limits.

In general, the electric furnace is used to accomplish three things:

- Purification of many ores is now a common practice.
- Ores available in a satisfactory chemical purity may have an undesirable crystal structure. This structure is alterable by electric furnace techniques.
- Compounds not available in the natural state can be synthesized by fusing selected raw materials.

There are many ways these three processes can be carried out in the electric furnace and we'll review the general form of each.

#### Arc Furnace: Most Common

Most common form of electric

furnace is the arc. It's the work horse of the steel, abrasive, refractory and electrochemical industries.

Two methods to generate heat in an arc furnace are shown above. In the direct-arc furnace, voltage is applied between two or more carbon or graphite electrodes, positioned above the furnace charge.

In most cases, the charge is a nonconductor of electricity at room temperature but becomes conductive at elevated temperatures. To fuse the charge it's necessary to lay a trench of coke on the surface of the charge, between each electrode. When the electrodes are lowered to this coke bed, a current flows generating heat, that, in turn, melts the furnace charge lying adjacent to it. The charge then becomes conductive and current flows from electrode to electrode through the molten bath.

Here, heat is generated in two ways: By radiation from the electric arc between the electrode and the bath, and through the resistance-heat effect within the bath. Both these sources of heat can be controlled rather closely by properly selecting operating conditions and by the design of equipment.

#### Purifying by Arc

When carrying out a purification process in an arc furnace, two ef-

fects can be accomplished. Impurities may be volatilized in the intense arc or they may be chemically reduced in the molten bath. There are definite reasons for using one or the other of these methods. Let's consider how materials can be purified in an electric arc furnace.

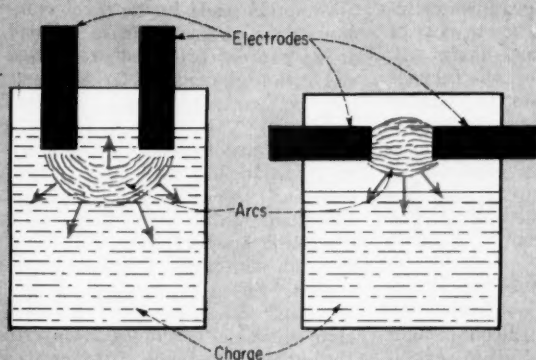
Commercial production of fused zirconium oxide, used as both a refractory and electrochemical, is a good example of purification. Natural source of zirconia is zircon sand, approximately  $\frac{1}{3}$  of which is silica  $\text{SiO}_2$ . It's desirable to eliminate this high percentage of silica and this can be achieved by two methods. Either method produces a fused zirconia  $\text{ZrO}_2$  containing as little as 0.10% silica.

To remove the silica as a fume, the furnace is operated at a relatively high voltage. This, in effect, positions the electrodes above the bath and draws a long arc in which the zircon sand melts by either radiated or conducted heat.

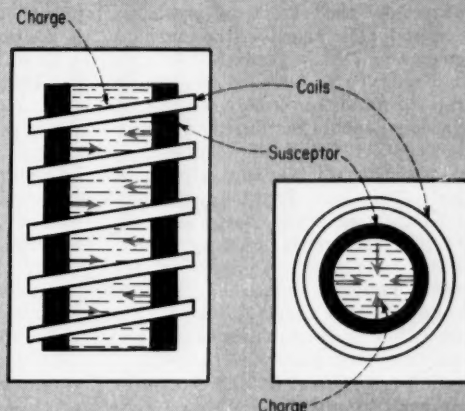
Silica, having a lower melting point than zirconia is evolved at about 1,700 C. and removed from the furnace area by a dust removal system. Resultant fused zirconia has a low silica content.

Such a process is commonly used to separate two oxide constituents of an ore. This process is practical when the two constituents have considerably different melting

## Arc Furnace Is Most Commonly Used



## Induction Furnace: Clean Operation



points. The lower melting oxide is readily volatilized and then recovered in a suitable dust collection system while the higher melting material is recovered as the fused mass.

To remove silica from zircon sand by chemical reduction, the furnace is operated at a lower voltage but with higher electric current. This higher current leads to high electrical resistance heat, that in turn leads to a hotter bath.

Now, if a form of iron is added to the bath, the silica combines to form a ferrosilicon that either sinks to the bottom because of its density or remains hung up and distributed throughout the product as discrete particles. These particles are later removed by magnetic treatment. This approach is also used commercially to produce fused aluminous oxides from bauxite ores.

It's interesting to note here the arc furnace's versatility. In the above example, the slag phase is actually the desired high-purity oxide product and the impurities are removed in the metal phase that becomes a byproduct. Of course, the opposite occurs in a steel furnace where the impurities are removed in the slag phase.

Indirect arc furnaces are used mainly in the steel industry. They consist of electrodes mounted horizontally, in line, some distance

above the furnace charge. An arc is drawn between the electrodes and resultant heat is transferred to the charge either by direct radiation from the arc or reflection from the furnace roof.

Arc furnaces have the advantage of being able to handle large quantities of materials reasonably economically. They suffer from the disadvantage of low thermal efficiency due to the difficulty of insulation and also because atmospheric control is difficult.

### Electrodes and Power—Related

Most arc furnace operations use either carbon or graphite electrodes. Graphite is considerably more expensive, purer, has greater strength and higher current carrying capacity than carbon.

Severity of operation and purity requirements of the product are generally the factors that determine the type of electrode you will choose.

Most furnaces use an extruded and machined electrode up to 6-ft. long. Screw joints of carbon or graphite are used to increase useful electrode length. Take care in selecting the proper type of joint. Large diameter nipples give a strong assembly. Small diameter nipples and greater electrode wall thickness at the joint are required

where a hot arc causes excessive electrode oxidation.

There are some operations, such as carbide furnaces, that use a continuously formed carbon electrode baked solid from the heat of the fusion.

Choice of single-phase or poly-phase operation is determined by several factors. Plants with very few furnaces generally operate with a three-phase, three-electrode set-up to maintain a balanced electrical load on the power supply.

Plants with a great number of furnaces may be operated single-phase and still maintain a balanced electrical load on the three-phase power supply by properly allocating single-phase power to each furnace.

Using single-phase or three-phase operation makes a difference in temperature distribution within the furnace. Therefore, it isn't desirable to use the same furnace design interchangeably.

### Resistance Furnaces

There are several forms of resistance furnaces as shown above. In general, this type of furnace uses heat generated by a carbonaceous resistor.

The open-type, direct-resistance furnace is widely used to make silicon carbide. In a silicon carbide furnace, a voltage is impressed on

an electrode at each end. Between the electrodes a carbonaceous material, in the form of rod or lump, acts as the starting resistor. Around this resistor the furnace charge is loosely packed.

This type of furnace is open on top to facilitate ready escape of gaseous impurities during fusion.

To start the fusion, current is passed through the central core or rod. This core heats up and immediately melts the charge adjacent to it. The carbon starting charge burns out very rapidly, but the fused material becomes sufficiently conductive to carry the load. Fusion thus proceeds from the central portion and grows radially to a point determined by the economics of power input.

This silicon carbide process is a good example of an electrothermal process where silica and carbon are combined in a high-temperature reaction with the evolution of large quantities of carbon monoxide gas.

This furnace doesn't lend itself to any atmospheric control. Its operation is also somewhat dependent on the electrical conductivity of the furnace charge.

Also common, is the closed resistor furnace using the above prin-

ciple. With this type of furnace, provision must be made for escaping gases. Closer control of atmospheric conditions with this furnace is possible.

Radiation from a graphite cylinder heated by resistance to flow of electricity is also very useful. In this type of application, the furnace charge is placed inside the cylinder in a highly refractory container.

Complete control over atmospheric conditions is possible. It lends itself to high-purity work but isn't a highly productive unit. Temperatures of the order of 2,500 C. are possible.

Another variation of resistance heating uses radiation from a resistor bar such as silicon carbide or zirconium oxide. Silicon carbide bars are useful in oxidizing conditions to about 1,500 C. Zirconia bars, that must be externally heated to about 1,500 C. to become conductive, are useful beyond 2,000 C. This type of heating is recommended for tunnel kilns in oxidizing atmospheres.

### Induction Furnaces

The induction furnace shown is very useful for temperatures up to 3,000 C. This furnace uses a high frequency generator, generally above 1 Kc., resulting in high temperatures in the susceptor. This comes from the susceptor's resistance to induce electric currents. Heat is radiated inward by the susceptor to where the furnace charge is placed. This furnace gives clean operation with good atmospheric control. It can be used for large-volume production of high-purity materials.

These three types of furnaces, the arc, resistance and induction, are now widely used. Newer types are being developed but aren't at this time commercially feasible.

Nuclear reactions, for instance, may generate temperatures of 1,000,000 C. But, there are few practical applications for this heating other than power generation.

Solar furnaces provide a very clean heat source that's operated to about 4000 C. Again, there are few practical applications.

Recent developments have been made using the ionized gas or plasma principle. This technique appears practical for generating temperatures from 8,000 to 15,000 C. However, it will probably be quite

some time before these principles are brought to commercial practice.

### Properties Are Variable

Products made in the three common types of operation mentioned above can be produced well-fused and with high density. Or, products can be partially fused, sintered materials.

In the arc furnace, well known to abrasive and refractory manufacturers, when molten material solidifies within the furnace, a gradation appears from well fused through sintered to unfused materials. Selective sorting of this material determines the physical characteristics of the product. With the open resistance furnace the same situation occurs. However, with closed resistance and with radiation resistance furnaces, degree of fusion is closely controlled by regulating the operating temperature. Similar control is possible with the inductance furnace.

Further control of product's physical characteristics is possible with arc and inductance furnaces.

Molten material is treated in such a manner that a wide variation in crystalline structure is obtainable. Molten material is cast into molds of varying size and shape that have a significant effect on the rate of crystal growth.

Techniques have been developed that make it possible to pour materials having a melting point well beyond 2,000 C. into cast iron containers. Mold life is amazingly long. It's also practical to pour molten materials into streams of gas, air, steam or water. This has the effect of producing spherical pellets, sometimes hollow, sometimes solid. As cooling in this case is very rapid, very fine crystal structure results.

Many high-temperature reactions can now be carried out on a commercial scale by ingenious application of electrical energy. The furnace you use in any given case is determined by several factors such as volume of production, purity of product, value of raw materials involved and economics of capital expenditures. However, advances in technology have widely opened a new realm in chemical processing. Tomorrow's world needs high temperatures, and the technology for providing suitable materials is keeping pace with the demand.

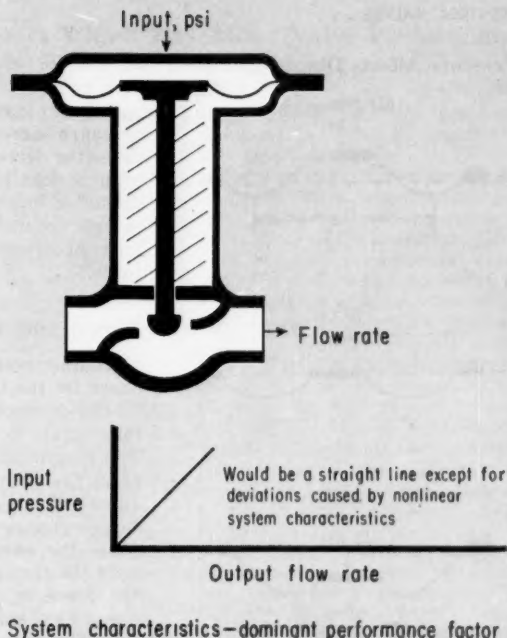


E. D. PORTER attended the U. of Saskatchewan and Queens University in Ont., Can., graduating from Queens in 1948 with a B. Sc. in Engineering Physics. He immediately joined Norton Co. as a research engineer. In 1954 Porter was selected to build Norton's Huntsville, Ala., electric furnace plant and then became its first resident manager. In 1957 he returned to Chippawa, Ont., as supervisor of technical services for the Electro-Chemical Division.



# How Control Valves Behave

For satisfactory valve operation, consider process and valve characteristics when selecting control valves.



WERNER G. HOLZBOCK, GPE Controls, Inc., Chicago, Ill.

SINCE a basic objective in control valve operation is linear response, an understanding of nonlinearities in valve behavior is essential. Among the characteristics which are frequently used as criteria for control valve performance are: linearity, hysteresis, deadband, resolution sensitivity, stiffness, speed, thrust and frequency response. Not all are of equal significance and some are of dubious value.

We shall examine these criteria as they apply to the air-operated diaphragm and spring control valve—the most common type in use.

Linearity is defined as the deviation from a linear output/input relation. For example: if the stroke (output) is 2 in. for a signal change (input) of 12 psig., then the linear output/input relation is 1 in./6 psig. This relation can be represented by a straight-line graph. Hence, valve position for any given pressure can be read from the graph.

Actually there are deviations in practical valve behavior. For example: if the valve position for a given air pressure deviates 0.1 in. from the position indicated on the graph, then the nonlinearity at this

point is 5% of the total stroke. Deviations from linearity may amount to 7 or 8% without impairing the performance of the control system. We can account for this deviation from linearity by examining the relation between manipulated and controlled variables.

Usually, the change of the manipulated variable (flow) and response of the controlled variable (temperature) is a characteristic of the process. Hence, the relation between these variables is not subject to alteration. The relation is not a steady one and depends on the nature of the load changes such

as greater heat demand of the product or decreased heat losses.

To compensate for nonlinearities in the process, the valve plug is generally characterized. This characterization provides an approximation to some idealized relation between valve travel and flow through the valve.

Thus, nonlinearities exist because of:

- Nonideal characteristics in the valve.
- Nonideal characteristics in the process.
- Nonconstant characteristics in the process.

Under such conditions, it is not realistic to look for excessive linearity in valve positioning. However, nonlinearities can become so large as to affect the dynamic response of the system. In this case they do become detrimental. Let us examine in detail the causes and effects of these nonlinearities.

## Springs and Diaphragms

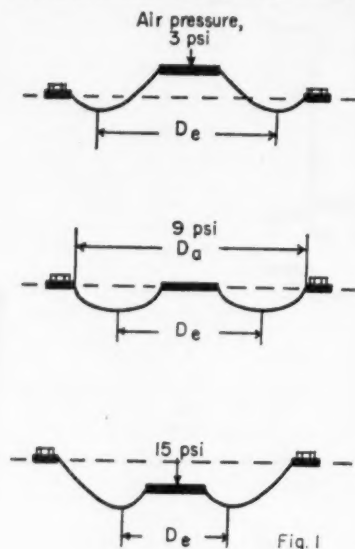
Range of the pneumatic signal to a control valve is generally 3 to 15 psig. As the air pressure exceeds 3 psig., the valve stem tends to move downward and thus compresses the

### More about valves . . .

With this article, we begin a series written by Werner G. Holzbock on the control valve and its positioning elements.

Subsequent articles by the author will cover valve construction including materials of construction; sizing of control valves; valve specification, maintenance and installation; operators and positioners for control valves.

## Pressure Affects Diaphragm Area



spring. In the ideal case, the force required to compress the spring is directly proportional to its deflection. This is not necessarily true under practical conditions.

Linear valve-stem travel requires among other conditions that the spring-rate be linear and that the effective diaphragm area be constant. However, spring linearity is hardly better than  $\pm 5\%$  and effective area of the diaphragm changes as it deflects.

The difference between actual diameter  $D_a$  of a diaphragm and effective diameter  $D_e$  is shown in Fig. 1. The part of the diaphragm outside of  $D_a$  is clamped between the rings. Effective diameter extends between points in the convolution. As the diaphragm moves, the configuration of the convolution changes.

In Fig. 1 the condition for a 3, 9 and 15-psig. signal is shown. Throughout the increase of the air signal, the effective diameter and, hence, area decrease. Suppose the effective diameter for the 3-psig. signal is 5 in. This is equivalent to an effective area of 19.63 sq. in. The resulting force equals  $3 \times 19.63$  or 59 lb. At 9 psig. the force should be tripled. Hence  $3 \times 59$  equals 177 lb. Suppose, however, the effective diameter changes from 5 to 4.9 in. The corresponding area is 18.86 sq. in. The resulting force is  $9 \times 18.86$

or 170 lb. which is a decrease of 7 lb. or about 4% in error.

This error increases as the signal pressure increases and the effective diameter decreases further. Hence, even a small change of effective diameter has a considerable effect in the accuracy of the conversion from pressure to the corresponding force.

## Thrust and Friction

Another nonlinearity may be produced by the thrust forces that act on the movement of the plug in the fluid whose flow is being regulated. The magnitude of thrust resulting from the pressure drop across the valve port and the dynamic flow forces changes with plug position. Since the spring force has to balance the thrust force in addition to the force caused by the air pressure, the valve position changes with variations in thrust.

Friction is another force that must be considered. It is mainly due to the packing which prevents the process fluid from leaking along the valve stem to the outside.

The larger the spring force, the less is the relative effect of thrust and friction forces. However, the diaphragm area must be correspondingly larger to be able to compress the spring.

Suppose the diaphragm area is 150 sq. in. A minimum air pressure of 3 psig. produces a force of 450 lb. and maximum air pressure of 15 psig., a force of 2,250 lb. If the stem travels a distance of 2 in. with the signal changing from 3 to 15 psig., a spring constant of  $(2,250 - 450)/2$  or 900 lb./in. is required. The spring is precompressed by 0.5 in. to provide the initial force of 450 lb.

Eckman\* shows that the maximum force available from a diaphragm and spring valve is limited by  $F < PA$  where  $F$  is the force in lb. acting in one direction on the valve stem,  $P$  is the input air pressure at zero stroke in psig. and  $A$  is the effective area of the diaphragm in sq. in.

If the thrust in the above example is 300 lb. when the valve begins to close, then the pressure must increase to 5 psig. before the valve begins to move. Since the diaphragm has an area of 150 sq. in.,

the increase of 2 psi. is necessary in signal air to produce the force of 300 lb. to overcome the thrust.

Similarly, if the valve is at mid-stroke and the thrust changes by 100 lb., valve position changes by 0.12 in. or 6% of its full stroke. This illustrates that a diaphragm and spring valve should only be used for comparatively small thrust forces. However, considerable improvement can be obtained by adding a valve positioner to the diaphragm and spring valve.

Friction acts in a similar manner. Suppose friction is great enough to require an extra 18-lb. force to start the valve stem moving. An increase of 0.12 psi. on the 150 sq. in. diaphragm is necessary to produce a force of 18 lb. to start motion of the valve stem.

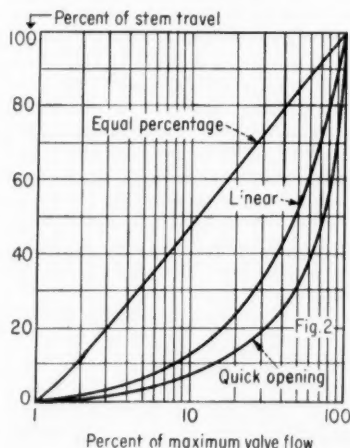
The increase of 0.12 psi. air pressure is equivalent to a pressure signal change of 1% of the total range from 3 to 15 psig. Hence at any position the signal may increase or decrease by 1% without moving the valve. This is equivalent to a dead-band of 2%, which may quite effectively contribute to instability in a system.

## Valve Characteristics

Previously outlined causes of nonlinearities are minor when compared with the nonlinearities that exist between the change of controlled variable to change in manipulated variable.

For example: temperature may be the controlled variable and steam

## Basic Valve Characteristics



\* D. P. Eckman, "Automatic Process Control," p. 197, John Wiley & Sons, Inc., New York (1958).

flow the manipulated variable. Increasing steam flow from 5,000 to 6,000 lb./hr. will not produce the same increment in temperature as an increase from 6,000 to 7,000 lb./hr. This effect is in the nonlinearity of the process. Process nonlinearity may become so large that it has a considerable effect on the stability of the system. The following example illustrates this process change.

Suppose an increase in signal pressure from 3 to 4 psig. moves the valve stem 0.1 in. Resulting temperature increase is 10° F. This means that the process gain is 10° F./1 psi. change of signal pressure. Now, assume that the signal pressure changes from 14 to 15 psig. moving the valve stem again by 0.1 in. However, nonlinearity of the process changes the temperature by 30° F. This means a process gain of 30° F./1 psi. change of signal pressure. Here, the gain increases three times toward the upper limit of the signal pressure. It is quite conceivable that the controller adjustments made at certain valve positions will produce oscillations when the process calls for an essential change in the valve position.

It is desirable in such cases to have a valve that in response to a signal change from 14 to 15 psig. opens the flow area by only one-third the amount it would open at a signal change from 3 to 4 psig. For this response the nonlinearities of the control valve compensate for the nonlinearities in the process.

The result is an approximately linear relationship between changes in signal pressure and changes in the controlled variable. Such compensations can only be approximate. Valves used for this purpose are said to be characterized. This is typical of most industrial control valves. Characterization of the valve depends on the process requirements.

Basic characteristics for quick-opening, linear and equal-percent-age valves are shown in Fig. 2. The quick-opening type gives maximum flow capacity with a comparatively small stem travel. Generally, they provide full flow capacity with about 20 to 30% stem travel. However, there are some exceptions where the first 20% of stem travel may provide about 30% of the maximum flow capacity. Therefore, they are faster around the closing point

## Additional Factors Which May Affect Valve Performance

► **Hysteresis** is a change in the output/input relation. The magnitude of the change depends on the previous history of the system such as the extent of magnetization. If the input signal varies through smaller and smaller cycles, hysteresis becomes less noticeable. Hysteresis may occur in springs but hardly becomes noticeable in valve operation. When mentioned in this connection, hysteresis is generally misapplied and mistaken for dead-band.

► **Dead-Band** is defined as the range of values through which the input can be changed without initiating output response. For example: if the input signal varies between 5.0 and 6.2 psi. and the valve starts moving only if the signal gets to either above or below these values, then dead-band is 1.2 psi. If the maximum signal change for valve operation is 12 psi., then the dead-band is 10%. Dead-band is the most important single characteristic of a control valve.

If a controller transmits a small signal change to the final control element without releasing action, this means (1) that the controlled variable is allowed to change through a certain range without corrective action taking place; and (2) that even if the deviation is larger than the dead-band, the controlling action is delayed. This lack of action contributes seriously to the instability of a control loop. The only remedy is to increase the proportional band and hence to slow down even further the speed of corrective action. While dead-band cannot be eliminated, it must be kept to a minimum to achieve stability in the control loop.

► **Resolution Sensitivity** according to ASME terminology is the minimum change of the input signal which produces an effective response of the output. Suppose the input signal in the previous example increases to 6.3 psi. The valve moves, then stops. To determine the resolution sensitivity the pressure is now further increased until the valve again starts to move. If the valve starts to move when the pressure reaches 6.4 psi., the resolution sensitivity is 0.1 psi. While this number determines the break-loose force or static friction, it does not take into account the backlash of the device. Only a combination of these factors tell how well the valve will perform in the

control loop. Hence, dead-band should be preferred as a performance specification.

The Scientific Apparatus Manufacturers Assoc. suggests another term, ultimate sensitivity which is defined as half the dead-band. However, SAMA recommends dead-band for performance specification. ► **Stiffness** of a valve, also called load sensitivity, describes valve response to thrusts which are active on the plug. For example: the position of a valve may change by 0.1 in. when the fluid presses against the plug with a force equal to 200 lb. Under this thrust the valve acts like a spring. Hence, stiffness may be expressed like a spring constant. In this case stiffness equals 2,000 lb./in.

Stiffness of a valve has a certain significance. It prevents the valve from responding to changes in thrust. However, where these changes are violent, abrupt and frequent, it is difficult to maintain adequate control due to process conditions. Minor responses of the valve to these changes will have the least effect.

Average thrust changes due to normal changes in valve position or slow thrust changes may cause some response in the valve without affecting control in a closed loop. However, stiffness remains an important criterion as shown on the preceding page under the general discussion for thrust and friction.

► **Frequency Response** is an expression of the ability of the valve to follow a rapidly changing signal. A valve may be slow in speed but be able to follow well the rapid changes of a very small signal. Hence, good frequency response does not necessarily imply fast action. Frequency response of a final control element can only be of interest if:

- Frequency response of all other components in the control system, including the process, are known to be low enough so as to derive any benefit from the high response of one specific component.

- Signals in the control system are rapidly changing and the control valve is expected to follow them. Then high frequency response becomes necessary.

- High frequency response is not actually objectionable. In some cases, it is undesirable to pick up fast random changes in the control system.

## Basic Valve-Plug Shapes

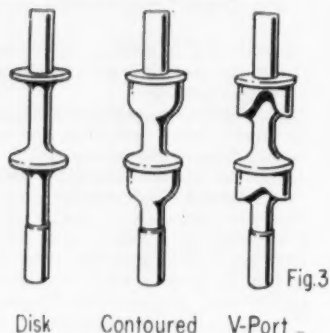


Fig.3

but then taper off and are essentially regulating over the whole stroke. Quick-opening valves are used mostly for open and shut applications or for rapid relieving capacity.

Linear valves have equal change of flow area for equal changes in stem travel. For example: a linear valve plug is 70% open passing steam at the rate of 5,000 lb./hr. Throttling the valve to 65% opening decreases flow by 500 lb./hr. to 4,500 lb./hr. Further throttling to 60% decreases the flow by another 500 lb./hr. to 4,000 lb./hr.

Now, let's consider an equal-percentage valve. Suppose the flow changes again from 5,000 to 4,500 lb./hr. in throttling the valve from

70 to 65% opening. This means a decrease of flow of 10%. Throttling the valve from 65 to 60% decreases the flow by another 10% or 450 lb./hr. to 4,050 lb./hr.

In selecting valve characteristics, detailed data regarding the process must be available. Where these data are lacking, use the equal-percentage valve if the following conditions apply: relatively long dead time or time constants, large load changes and use of oversized valve. Normally, a valve is sized to operate at maximum process flow with about 80% of its port area open.

Valve characteristics define the change of area of valve opening with stem travel. The relation between area and stem travel depends on the shape of the valve plug. There is a large variety of such plugs. According to their basic shape, they can be disk, V-shaped or contoured plugs as shown in Fig. 3. These basic shapes are offered by all valve manufacturers. Valves are modified to give various characteristics which approximate linear, quick-opening, equal-percentage or any other characteristic that may be required.

An advantage of V-port plugs is that the plug walls slide inside the port walls. The ports serve as a guide for the plugs. Contoured plugs lack this support and special guides are often required. However, where corrosion particles, solids in suspension, sealing or high viscosity fluids are present, a contoured plug is better suited than the V-port plug which clogs more readily.

Both V-port and contoured plugs lend themselves much better to characterization than do disk plugs. One particular shortcoming of V-port and contoured plugs is their limited rangeability. Hence, at small flows these valves can not produce stable control. The sharp break which occurs in their design characteristics prevents using the valve at or below a certain percentage of flow.

## Rangeability Factors

Rangeability factors express the usable range of a valve. If the valve can be used between 2 and 100% of its stem travel, the rangeability factor is 100/2 or 50. If the valve stem travel is limited to a range between 10 and 100%, its rangeability is 100/10 or 10. Manufac-

turers of control valves supply these rangeability factors. A good practice is to expect an average rangeability of 8, approaching 15 on larger valves but decreasing to as low as 5 on small valves.

In determining the rangeability for a valve, it is necessary to account for pressure differential across the valve as well as flow capacity through the valve. Required rangeability  $R$  is expressed by

$$R = \frac{Q_1}{Q_2} \left( \frac{p_2}{p_1} \right)^{0.5}$$

where  $Q_1$  is the maximum flow with its pressure differential  $p_1$  and  $Q_2$  is the minimum flow with its pressure differential  $p_2$ .

Usually at lower flows, the pressure differential across the valve is larger because the pressure drop in the system upstream of the valve decreases with flow. Hence, the available pressure at the valve becomes larger. However, there are many conditions which can modify this statement.

For example: process conditions are such that for a maximum flow of 360 gpm. there is a pressure differential of 12 psi. and for a minimum flow of 60 gpm. there is a pressure differential of 27 psi. Substituting these values in the preceding equation, calculations show that a rangeability factor of 9 is required.

Disk valves have no limitation in rangeability. They can be used in controlling flows throughout their range. Most of them are quick-opening valves. However, there are exceptions like the Taylor Hi-Flow valve. The disk and seat-ring on which the disk comes to rest are shaped so that a linear characteristic results while the advantage of full-range operation is maintained for all flow patterns.

Valve characterization and designation vary from manufacturer to manufacturer. The action of an actual equal-percentage valve may show considerable deviations from an ideal equal-percentage valve. The same is true of linear valves. Hence for any given valve, the manufacturer's literature is the best source of information for valve characteristics.

The valve manufacturer's data show approximately in what portion of the valve movement the maximum, minimum or any intermediate increase of flow rate through the valve occurs.

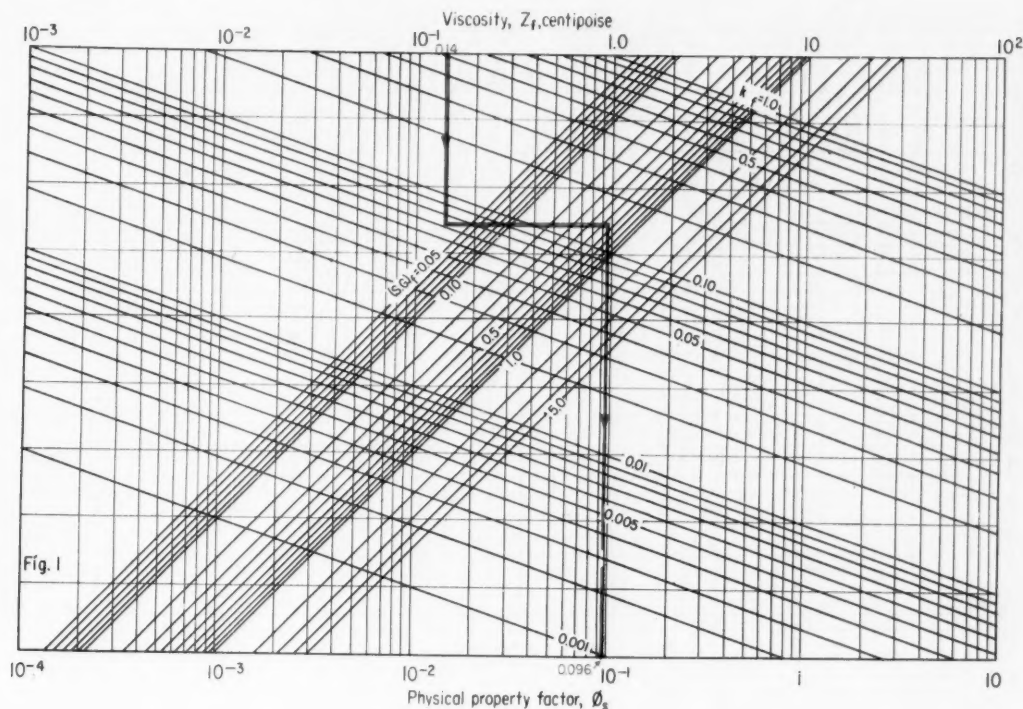


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He is the author of two well-known books in the field, "Automatic Control: Principles and Practice" and "Instruments for Measurement and Control."



## Chart Gives Physical Property Factor for Condensing Coefficient—Streamline Flow



## Graphs Speed Evaluation of . . .

# Condensing and Boiling Coefficients

## . . . of Heat Transfer

NING HSING CHEN, Heat Transfer Div., M. W. Kellogg Co., Jersey City, N. J.\*

ALL charts in this article are based on equations that are either: (1) purely theoretical or (2) empirical but not completely proved. Nevertheless, when properly used, these graphical short-cuts will save much of your time and effort, and will provide answers that agree quite well with experimental data.

### Find Condensing Coefficients

Nusselt's correlation equation<sup>1</sup> for the computation of condensing coefficients for vertical tubes is:

$$h_m = 1.47(4G_v/\mu_f)^{-1/3}[\mu_f^2/(k_f^3\rho_f^2g)]^{-1/3} \quad (1)$$

For horizontal tubes, the equation is:

$$h_m = 1.51(4G_h/\mu_f)^{-1/3}[\mu_f^2/(k_f^3\rho_f^2g)]^{-1/3} \quad (2)$$

These equations are based on the assumption that the condensate films are in viscous flow.

\* To meet your author, see *Chem. Eng.*, June 30, 1958, p. 140.

If we replace both  $G_v$  and  $G_h$  with  $G$ , and if we use a value of 1.50 to replace both constants (very little error is introduced), Eqs. (1) and (2) reduce to:

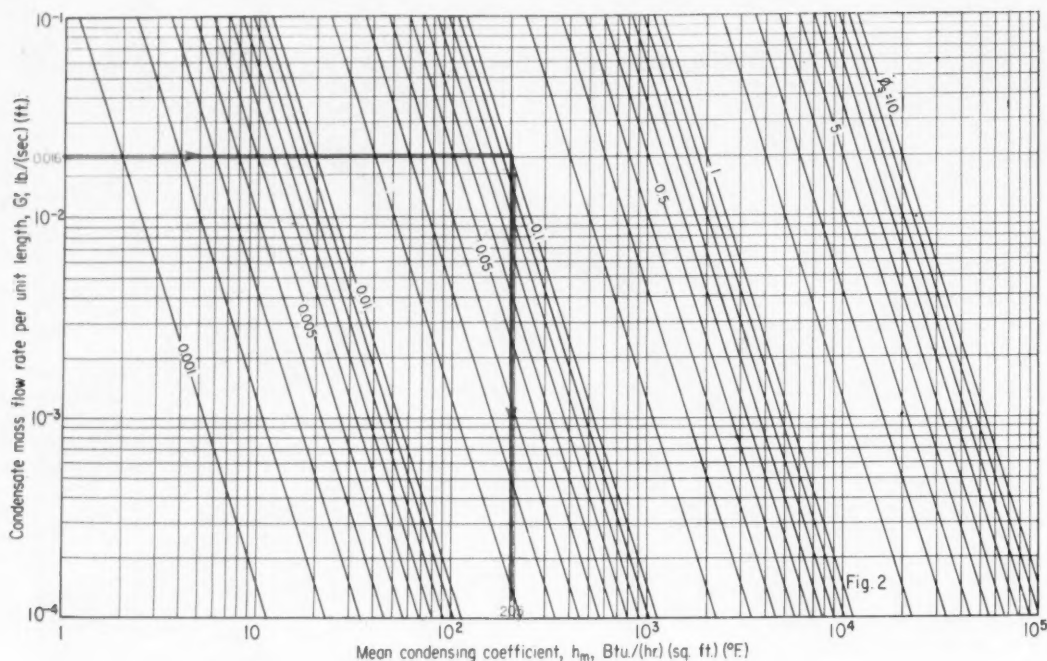
$$h_m = 1.50(4G/\mu_f)^{-1/3}[\mu_f^2/(k_f^3\rho_f^2g)]^{-1/3} \quad (3)$$

On grouping of physical properties after conversion to common engineering units, Eq. (3) becomes:

$$h_m = 540\phi_s/(G')^{1/3} \quad (4)$$

Eq. (4) is used to construct Figs. 1, 2 and 2A. Since the basic equations assume streamline flow, employ Figs. 1, 2 and 2A only when  $4G_h/\mu_f < 4,200$  and  $4G_v/\mu_f < 1,800$ .

McAdams recommends the Kirkbride and Badger correlation<sup>2</sup> for cases where condensate films are in turbulent flow, or  $4G/\mu_f > 1,800$ . This equation states:

Use Graph to Find Condensing Coefficient—Streamline Flow,  $G' < 0.1$ 

$$h_m [\mu_f^2 / (k_f^2 \rho_f^2)]^{1/2} = 0.0077 (4G' / \mu_f)^{0.4} \quad (5)$$

It can also be expressed in the form:

$$h_m = 1,610 \phi_t (G')^{0.4} \quad (6)$$

We base Figs. 3 and 4 on Eq. (6). The following

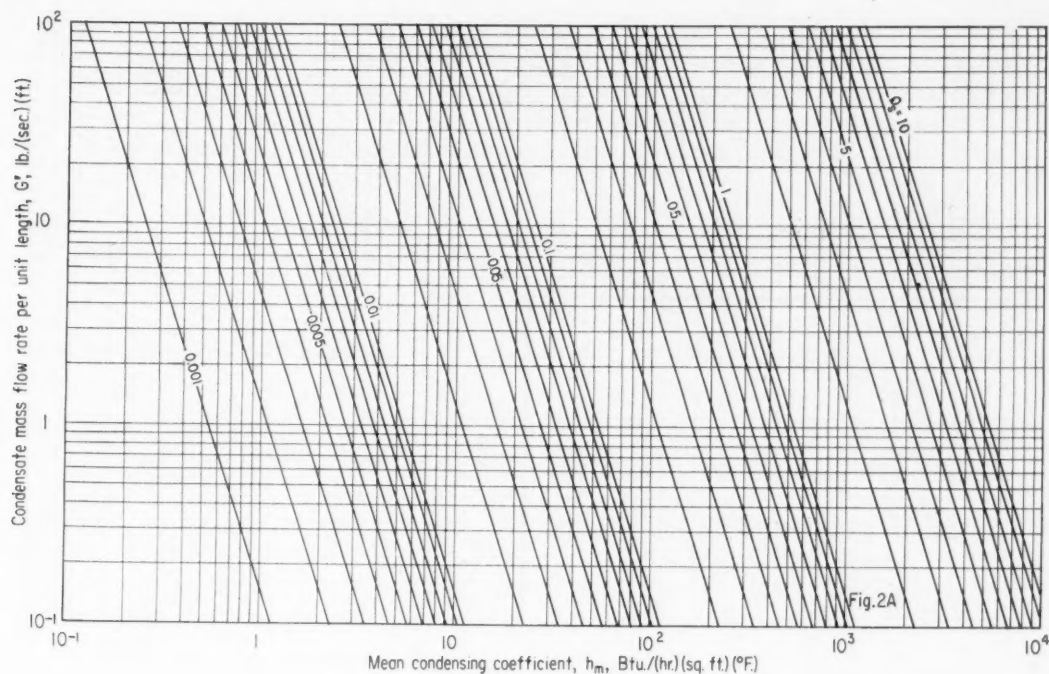
two problems will illustrate proper application of all four charts.

**Problem 1 (Streamline Flow)**—Find the condensing coefficient for a vapor at the following set of conditions:  $G' = 0.0162$  lb./sec. (ft.);  $k_f = 0.075$  Btu./

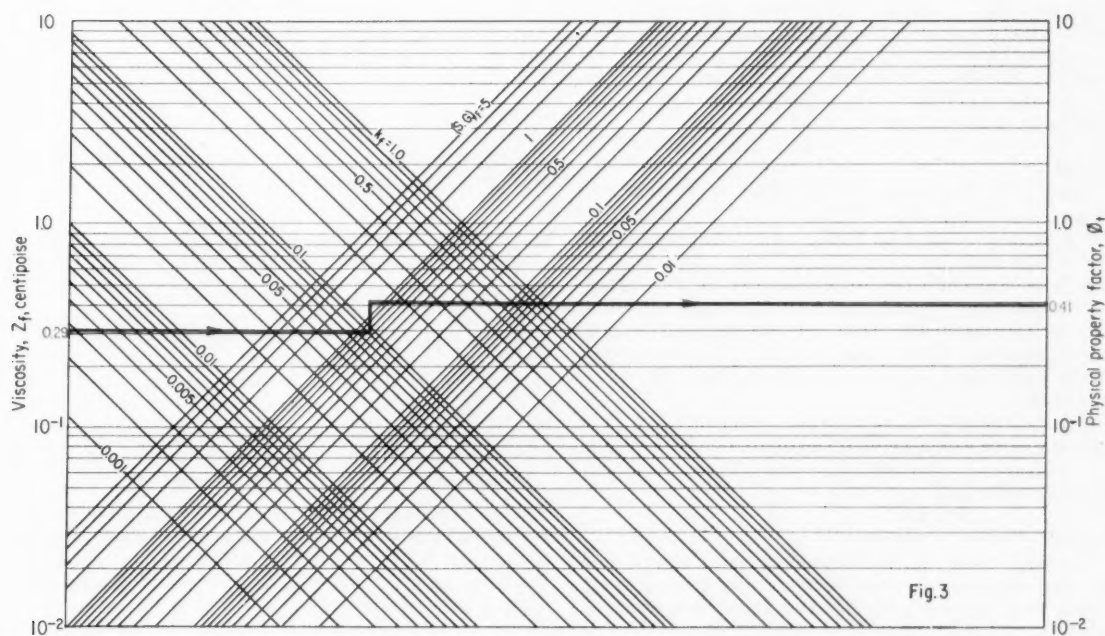
## Nomenclature

$A$	Heating surface, sq. ft.	$(S.G.)_f$	Specific gravity of condensate at film temperature, referred to water.
$C$	Specific heat of boiling liquid, Btu./(lb.) (°F.).	$W$	Mass rate of boiling vapor, lb./hr.
$D$	Outside tube diameter, ft.	$W'$	Mass rate of boiling vapor, lb./sec.
$D'$	Outside tube diameter, in.	$Z$	Viscosity of boiling liquid, centipoise.
$F_p'$	Pressure correction factor, $(\pi'/14.7)^{0.86}$	$Z_f$	Viscosity of condensate at film temperature, centipoise.
$F_{\mu}'$	Tube-size correction factor, $(0.625/D')^{0.3}$	$\mu$	Viscosity of boiling liquid, lb./(hr.) (ft.).
$G$	Condensate mass flow rate per unit length of either horizontal or vertical tubes, lb./(hr.) (ft.).	$\mu_f$	Viscosity of condensate at film temperature, lb./(hr.) (ft.).
$G'$	Condensate mass flow rate per unit length of either horizontal or vertical tubes, lb./sec. (ft.).	$\pi$	Pressure, psfa.
$G_h$	Condensate mass flow rate per unit length of horizontal tubes, lb./hr. (ft.).	$\pi'$	Pressure, psia.
$G_v$	Condensate mass flow rate per unit length of vertical tubes, lb./hr. (ft.).	$\rho_f$	Density of condensate at film temperature, lb./cu. ft.
$G_z$	Mass velocity of boiling liquid, lb./(hr.) (sq. ft.).	$\rho_L$	Density of boiling liquid, lb./cu. ft.
$g$	Gravitational acceleration, ft./hr. <sup>2</sup>	$\rho_v$	Density of vapor, lb./cu. ft.
$h$	Nucleate boiling coefficient, Btu./(hr.) (sq. ft.) (°F.).	$\sigma$	Surface tension of boiling liquid, lb. mass/ft.
$h_m$	Mean condensing coefficient, Btu./(hr.) (sq. ft.) (°F.).	$\sigma'$	Surface tension of boiling liquid, dynes/cm.
$k$	Thermal conductivity of boiling liquid, Btu./(hr.) (sq. ft.) (°F./ft.).	$\phi_s$	Physical property factor for streamline flow, $k_f (S.G.)^{2/3} / Z_f^{1/3}$
$k_f$	Thermal conductivity of condensate at film temperature, Btu./(hr.) (sq. ft.) (°F./ft.).	$\phi_t$	Physical property factor for turbulent flow, $k_f (S.G.)^{2/3} / Z_f^{1/3}$
		$\phi_1$	Physical property factor, $C^{0.4} k^{0.6} / Z^{0.3}$
		$\phi_2$	Physical property factor, $\rho_L^{0.275} / [\sigma^{0.435} \rho_v^{0.7}]$

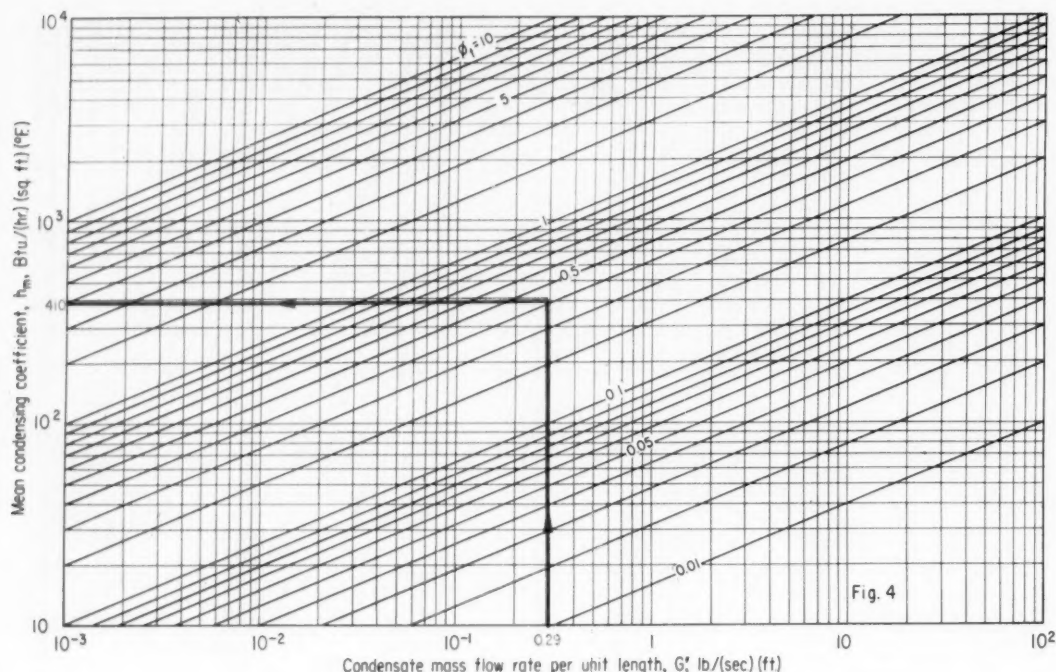
**Use Graph to Find Condensing Coefficient—Streamline Flow,  $G' > 0.1$**



**Chart Gives Physical Property Factor for Condensing Coefficient—Turbulent Flow**



## Use Graph to Find Condensing Coefficient—Turbulent Flow



(hr.) (sq. ft.) (°F./ft.);  $(S.G.)_f = 0.55$ ; and  $Z_f = 0.14$  centipoise.

**Step 1**—Obtain the physical property factor from Fig. 1. Drop a line through  $Z_f = 0.14$  to meet  $k_f = 0.075$ . From this point, draw a horizontal line that meets the  $(S.G.)_f$  line for 0.55. Read the abscissa of this last intersection on the bottom scale as  $\phi_i = 0.096$ .

**Step 2**—Find the mean condensing coefficient  $h_m$  from Fig. 2. To do this, first draw a horizontal line through  $G' = 0.0162$  to meet the line for  $\phi_i = 0.096$ . Then drop a line to the abscissa and read  $h_m$  as 205 Btu./hr. (sq. ft.) (°F.). Use Fig. 2A instead of Fig. 2 when  $G' > 0.1$ .

**Problem 2 (Turbulent Flow)**—Find  $h_m$  for the following conditions:  $G' = 0.29$ ,  $Z_f = 0.28$ ,  $(S.G.)_f = 1.26$  and  $k_f = 0.09$ . At these conditions, condensate flow is turbulent, so we must use Figs. 3 and 4.

**Step 1**—Estimate the turbulent-flow physical property factor from Fig. 3. Draw a horizontal line through  $Z_f = 0.29$  to meet  $k_f = 0.09$ , and then extend vertical line to meet the  $(S.G.)_f$  line of 1.26. The ordinate of this last intersection appears on the right-hand scale as  $\phi_i = 0.41$ .

**Step 2**—On Fig. 4, erect a line through  $G' = 0.29$  to meet the  $\phi_i$  line of 0.41. The ordinate of this intersection is shown on the left-hand scale. Thus, mean condensing coefficient  $h_m = 410$ .

## Compute Boiling Coefficients

To date, there is no completely satisfactory heat transfer equation for the correlation of boiling coefficients with process variables and equipment specifica-

tions. However, Gilmour's equation<sup>2</sup> for nucleate boiling, recently presented before the 2nd National Heat Transfer Conference (AIChE-ASME), checks out quite well with experimental data from a wide variety of sources.

Although still in the debate stage, Gilmour's equation will serve as the basis for this article's short-cut charts. The equation is:

$$(h/CG_z)(C\mu/k)^{0.6}(\rho_L\sigma/\pi^2)^{0.425} = 0.001/(DG_z/\mu)^{0.3} \quad (7)$$

where  $G_z = (W/A) (\rho_L/\rho_V)$ .

Converting to common engineering units and regrouping the variables, we get:

$$h = 2,100\phi_1\phi_2 \left[ \frac{(\pi')^{0.85}(W)^{0.7}}{A^{0.7}(D')^{0.3}} \right] \quad (8)$$

Figs. 5, 6, 7 and 8 are based on Eq. (8).

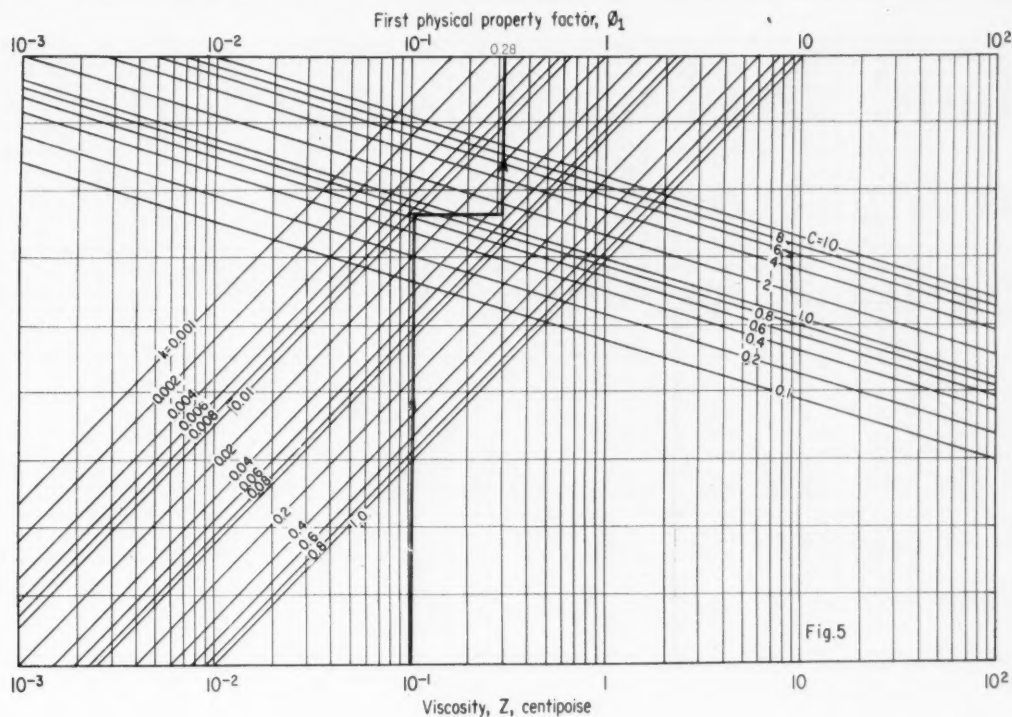
**Problem 3**—Find the boiling coefficient<sup>1</sup> if equipment data and fluid conditions are as follows:

$A = 356$ sq. ft.	$W = 40,800$ lb./hr.
$C = 0.73$ Btu./lb. (°F.)	$Z = 0.1$ centipoise
$D' = 0.75$ in.	$\rho_L = 26.8$ lb./cu. ft.
$k = 0.0528$ Btu./hr. (sq. ft.) (°F./ft.)	$\rho_V = 2.27$ lb./cu. ft.
$\pi' = 290$ psia.	$\sigma' = 3.1$ dynes/cm.

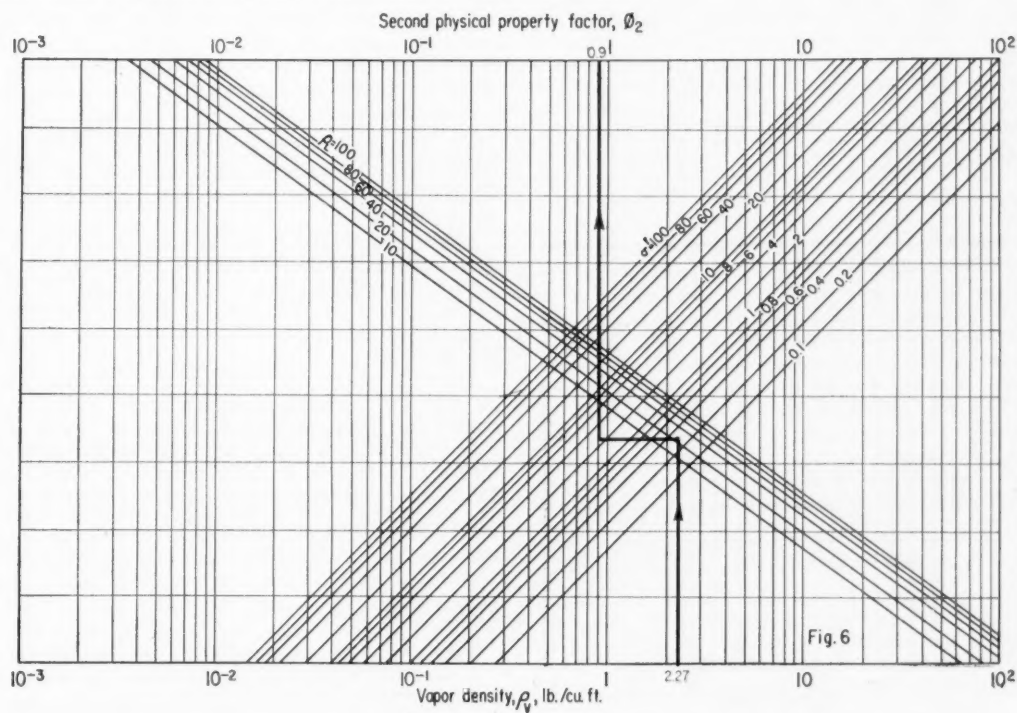
**Step 1**—Obtain the value for physical property factor  $\phi_1$  from Fig. 5. Erect a line through  $Z = 0.1$  to meet  $C = 0.73$ . From this point, draw a horizontal line to meet  $k = 0.0528$ . The abscissa of this intersection, shown on the top scale, is  $\phi_1 = 0.28$ .



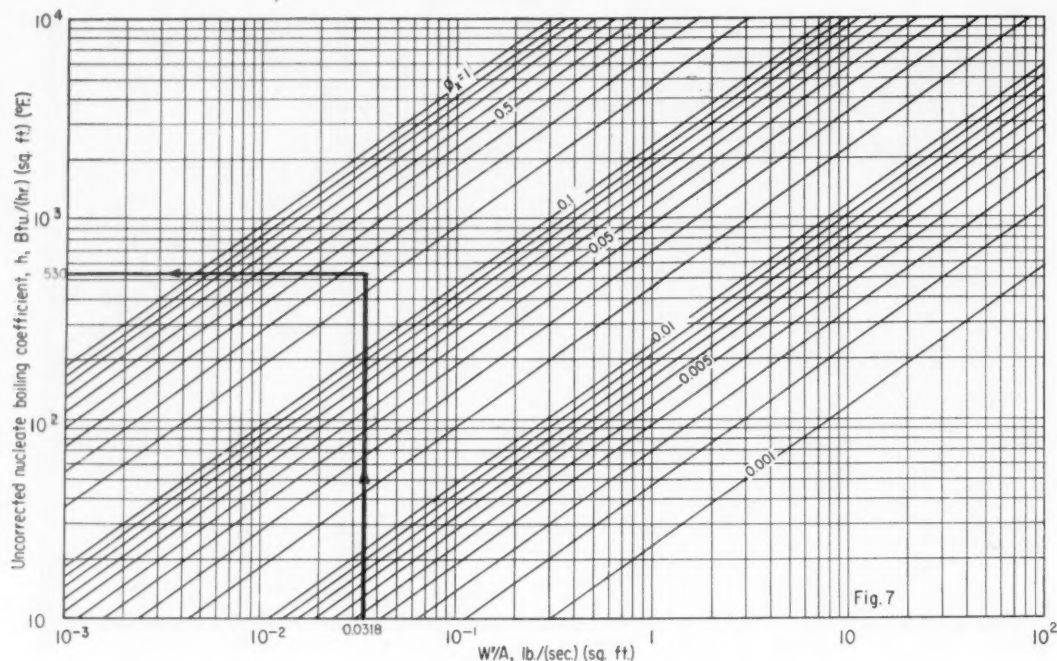
### Find First Physical Property Factor for Boiling Coefficient



### Find Second Physical Property Factor for Boiling Coefficient



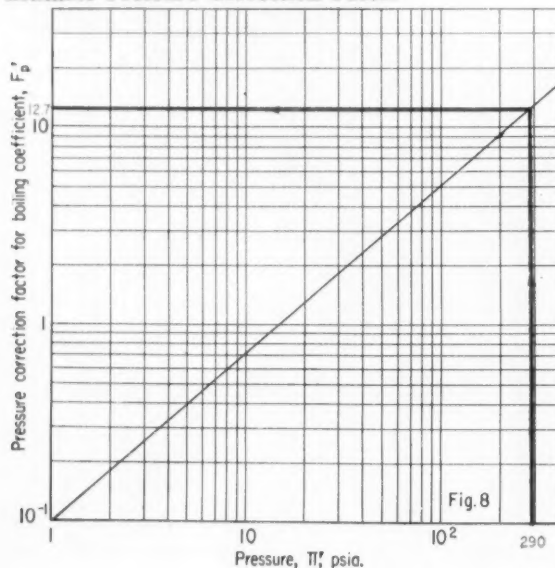
## Graph Gives Uncorrected Nucleate Boiling Coefficient



## Tube-Size Correction Factors

Size	$F_{D'}$	Size	$F_{D'}$
5/8 in. O.D.	1.000	1 in.	0.866
3/4 in.	0.945	1 1/4 in.	0.811

## Estimate Pressure Correction Factor



Step 2—Read the value for  $\phi_s$  from Fig. 6. Erect a line through  $\rho_v = 2.27$  to meet  $\rho_L$  of 26.8. Then draw a horizontal line to meet the  $\sigma'$  value of 3.1. The abscissa of this last intersection is shown on the top scale as 0.9.

Step 3—Find the boiling coefficient from Fig. 7. To do this, erect a line through  $W/A = 40,800/(356 \times 3,600) = 0.0318$  lb/(sec.) (sq.ft.) to meet  $\phi_s = 0.25$ . ( $\phi_s = \phi_1 \times \phi_2 = 0.28 \times 0.9 = 0.25$ .) The left-hand ordinate of this intersection is  $h = 530$  Btu/(hr.) (sq. ft.) (°F.).

Multiply this value of the uncorrected boiling coefficient by the pressure correction factor  $F_p$  and by the appropriate tube-size correction factor. From Fig. 8,  $F_p = 12.7$  at  $\pi' = 290$  psia.; tube-size correction factor for  $D' = 0.75$  in. is 0.945 (from table below Fig. 7). Thus, corrected boiling coefficient  $h = 530 \times 12.7 \times 0.945 = 6,350$ .

## REFERENCES

1. Gilmour, C. H., *Chem. Eng.*, Aug., p. 199 (1954).
2. Gilmour, C. H., Preprint No. 27, 2nd. Nat. Heat Transfer Conf. (AIChE-ASME), Aug. 1958.
3. McAdams, W. H., "Heat Transmission", p. 266, McGraw-Hill Book Co., Inc., New York (1950).
4. Nusselt, W., *Z. Ver. Deut. Ing.*, 60, pp. 541, 569 (1916).

# Instrument Scale Error Study Throws New Light on Flowmeter Accuracy

Why different kinds of flowmeters have different kinds of scales.

How scales affect reading accuracy.

How to evaluate scale error in your present meters.

How scale-reading accuracy can help select new meters.

**WILLIAM BUZZARD, Fischer & Porter Co., Hathboro, Pa.**

**W**HEN selecting flow instruments, we usually consider the mechanics of the sensing unit—how well it will perform in the particular process—but frequently we overlook the nature of the instrument scale. The instrument scale is a result of the physical relationship between flow rate and the measured variable (pressure drop, variable area, or head across the measuring element).

It is important to consider instrument scale because indicated flow rate accuracy, and therefore control accuracy, is dependent upon it. If your work involves either selection or use of flowmeters, you should be acquainted with the error that scale introduces in a flow measuring system.

Although there are many flow measuring devices in use, for our discussion we divide them into six categories according to the nature of their scales. Most commonly, the scales are either square root, arising from such primary measuring elements as orifice plates and venturis, or linear, arising from

rotameters. However, there may also be 1.5 and 2.5 power scales, logarithmic scales, and random non-linear scales derived from special calibration of instruments operating under unusual conditions. The table on the next page classifies the primary elements according to the scales that they produce.

We're not going to consider the accuracy of the flow measuring elements themselves in this discussion. Their accuracy is dependent upon factors of in-line installation and operation that will vary from case to case. We are going to consider the error in the indicated (or recorded) flow rate that occurs when an instrument of a given inherent accuracy measures a primary element signal. This signal is related to flow, as shown in the table, by the instrument scale.

For our comparison, we make two assumptions that hold for all categories. First, we assume that the instrument being used is inherently accurate at all points to 0.5% of the full range. We also assume that we want the error of

the indicated flow rate to be no worse than 2%. This latter assumption in effect says: "We will select no primary element that—together with our particular instrument—gives us a flow rate error greater than 2% anywhere in the flow range".

We define flow rate error (expressed in percent) as the quotient of absolute flow rate error and flow rate, multiplied by 100. We then apply this general error definition to the particular case of each scale category. The result is an expression for flow rate error that is unique to each scale. A typical expression (that for the square root scale) is derived on p. 150, and expressions for all scale categories, similarly derived, are included in the table.

## Six Kinds of Scales

The linear scale, evenly divided, is undoubtedly the easiest read and understood scale. When our two assumptions are applied, the error expression reveals that the instru-

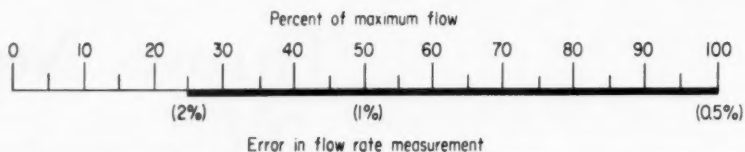
## Compare Accuracy of Indicated Flow Rate

Scales Produced by Primary Elements

Usable Flow Range (Under Text Assumptions)

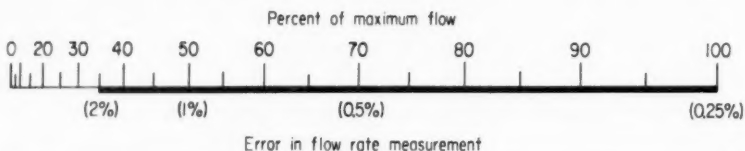
### Linear, $Q=h$

(Variable-area meters, electromagnetic meters, turbine meters, sonic meters, linearly characterized non-linear devices.)



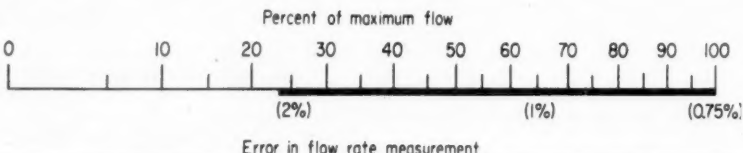
### Square root, $Q=10h^{0.5}$

(Orifice plates, venturis, flow nozzles, other d/p devices; pitot tubes, flow tubes, elbow taps, other impact pressure devices.)



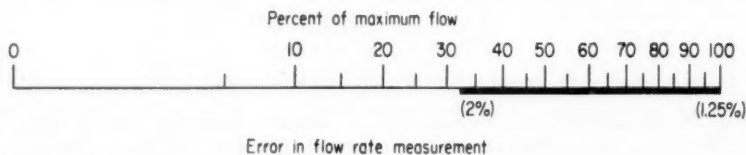
### 1.5 Power, $Q=h^{1.5}/10$

(Rectangular and Cippoletti weirs, Parshall flume, other open-channel-type devices.)



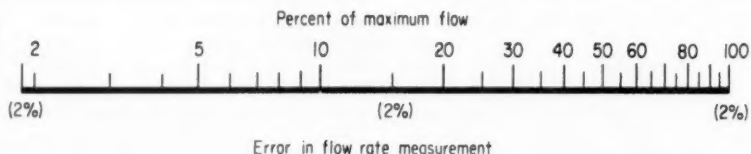
### 2.5 Power, $Q=h^{2.5}/1,000$

(V-notch weirs, 60° and 90°.)



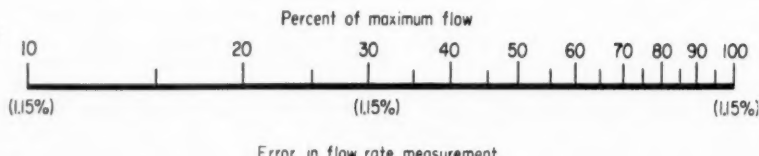
### Logarithmic, $h=57.5 \log(Q/1.82)$

(Log-characterized rotameters & turbine meters.)



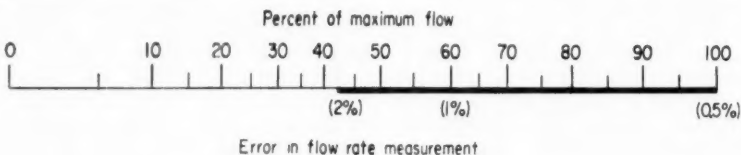
### Logarithmic, $h=100 \log(Q/10)$

(Log-characterized rotameters & turbine meters.)



### Random nonlinear, $Q-h$ empirical

(May be any of the above elements under special flow conditions; scale empirically determined.)





Flow Error Expression

Remarks

$$100 \Delta h/Q$$

Linear scale is best for widely varied flows. Normal flow should be 50-80% of maximum.

$$5,000 \Delta h/Q^2$$

Best flow accuracy of all scales at high flow rates. Accuracy deteriorates quickly below 50% of maximum flow. Normal flow should be 70-90% of maximum.

$$32.75 \Delta h/Q^{0.67}$$

$$15.75 \Delta h/Q^{0.4}$$

$$4 \Delta h$$

Equal flow accuracy throughout entire flow range; the shorter the range, the greater accuracy.

$$2.3 \Delta h$$

Equal flow accuracy throughout entire flow range; the shorter the range, the greater accuracy.

Find  $dQ/dh$  graphically; substitute in general flow error expression.

ment can handle all flows from 100 to 25% of the maximum flow, a "rangeability" (or ratio of highest to lowest usable flow rates) of 4 to 1. The heavy line on the flow scale (in the table) indicates the usable flow portion of the scale.

The square root scale offers the best accuracy of all scales at high flow rate. Compared to other scales, however, its accuracy drops off sharply below 50% of maximum flow. Based on our assumptions, it is possible to use flows from 35 to 100% of maximum, a rangeability of only 2.8 to 1. If process flow rate is going to be fairly constant, the square root scale is acceptable, but if flow should be varied widely, the linear scale is more advantageous.

The scales for elements such as weirs and flumes that measure flow in open channels are power functions—usually 1.5 or 2.5 power. Under our criteria, these scales offer rangeability of 4.3 to 1 and 3.2 to 1 respectively, but you will note in the table that accuracy at high flow rate is not as good as that for the linear and square root scales.

Logarithmic scales are produced by characterized\* measuring elements. Log scales are ideal in the sense that the flow rate error is constant throughout the entire range. However, error increases with greater rangeability. Two examples of logarithmic scales, one with rangeability of 55 to 1 and the other with rangeability of 10 to 1, are presented in the table to show the effect of rangeability on the error. Logarithmic scales are not often used in industrial process instrumentation, but they are employed in laboratory and engine test stand applications.

A random nonlinear scale might be produced under special flow conditions. For example, let's consider a low capacity rotameter. Flow might be turbulent at upper scale values but laminar at lower values. The flow coefficient would change over the range of interest causing nonlinearity. This scale would have to be determined by calibration. Although many flow measuring devices may be calibrated for such abnormal conditions, usually the technique is limited to small orifice runs, pitot tubes, small rotameters, or rotameters measuring high viscosity fluids.

\*By "characterize" we mean that, by design modification, we can make an element produce a signal other than that which it normally would.

By substituting your own particular criteria for those that we have assumed in this discussion, you can determine flow rate error introduced by scale in the same way we have. Use the flow rate error expressions listed in the table, or derive your own for special cases, following the model in our derivation.

Scale selection is important for other reasons in addition to the one discussed above of knowing how accurate your flow reading is. Let us next consider some of the ways in which these scales limit the flow control system.

One of the effects of scale error is the contribution to over-all measurement-control system accuracy. For example, if controller errors are added to the instrument error we assume (0.5% of full scale), the system might now be accurate to only 1% of full range. If this is the case, and if 2% flow rate accuracy is still desired, both square root and linear scales now provide rangeability of 2 to 1. The 2.5 power scale, however, cannot provide the desired 2% accuracy anywhere in its range. The logarithmic scale, on the other hand, can provide 7.4 to 1 rangeability. (These rangeabilities are determined by substituting 1% for  $\Delta h$  rather than 0.5% as with our orig-

inal assumptions, and then finding the lowest flow rate that will still give the desired 2% accuracy.)

There are certain control arrangements that are dependent upon the selection of scale. For example, let us consider the requirements for flow signal summation. If two or more flow rate signals must be added or subtracted, the signals must be linear. The ranges of the signals for summation need not be identical, but instrumentation is usually simplified if they are. Equipment is available for both pneumatic and electric summation; so too is there equipment for the artificial linear characterization of, say, a square root signal to make summation with such a signal possible.

If one flow rate is to be controlled at some ratio to another flow rate, the same type scale for each must be chosen. The only difference that various scales introduce in ratio control is a difference in rangeability. A ratio controller that will handle linear ratio signals of 16 to 600% of the normal ratio will only handle square root ratio signals of 40 to 240%.

To measure mass flow of a gas subject to variable temperature and pressure, it is necessary to make a correction for changes in density. Since density is a function of temperature and pressure, and since mass flow is a function of the square root of density times the square root of pressure drop, it is convenient to have the instrumentation perform the necessary arithmetic and then display the results on a square root scale to read mass flow directly.

Although we have mentioned above that it is sometimes possible to characterize a signal of one type scale artificially so as to obtain that of another type scale, it is not always wise to do so. Any component added to the transmission system will increase the over-all error. However, when such conversion must be made, and it does not upset the accuracy requirements, characterization may be built into the system by any of several hardware devices. These devices—calculating relays, fixed contour devices (cams), and adjustable contour devices—can be employed to characterize almost any one of the scale categories we've talked about to any other.



WILLIAM BUZZARD is a senior systems engineer with Fischer & Porter. Joining the company in 1952 after six years of process experience in the pulp and paper industry, Buzzard holds a B.S. in chemical engineering from M.I.T. and served in Europe during World War II. He is a member of the Instrument Society of America.

## Derivation of Flow Error Expression

We define flow rate error, expressed in percent, as

$$\% F.E. = \frac{\text{Absolute flow rate error}}{\text{Flow rate}} \times 100$$

$$= \frac{\Delta Q}{Q} \times 100 \quad (1)$$

Since chart pen or indicator position indicate the functional scale relation between flow rate and measured variable, and since it is the error involved in this scale relation that we are interested in, it is convenient to relate flow rate error and indicator error.

$$\frac{\text{Absolute flow rate error}}{\text{Indicator error}} = \frac{\Delta Q}{\Delta h} \approx \frac{dQ}{dh}$$

Substituting for  $\Delta Q$  in the flow rate error definition, Eq. (1)

$$\% F.E. = \frac{100 \Delta h}{Q} \frac{dQ}{dh} \quad (2)$$

This is a generalized flow error expression that can be used for any of the scale categories represented in the table. In order to show the error expression for a specific scale, we will derive the case of the square root scale.

The square root scale is based on proportionality between percent of maximum flow  $Q$  and square root of differential pressure across the measuring element, which is the measured quantity or indicator position  $h$ . The relation, stated mathematically, is

$$Q = kh^{0.5}$$

Since  $h = 100$  when  $Q = 100$ ,

$$Q = 10 h^{0.5} \quad (3)$$

If we differentiate Eq. (3),

$$dQ = 5h^{-0.5} dh$$

$$\frac{dQ}{dh} = 5h^{-0.5} \quad (4)$$

Substituting Eq. (4) in the generalized expression for flow rate error, Eq. (2),

$$\% F.E. = \frac{100 \Delta h}{Q} \frac{dQ}{dh}$$

$$= \frac{100 \Delta h (5h^{-0.5})}{Q} \quad (5)$$

When Eq. (5) is combined with Eq. (3) to eliminate  $h$ ,

$$\% F.E. = \frac{5,000 \Delta h}{Q^2} \quad (6)$$

Other scale errors are similarly derived. They are summarized in the table. We see from Eq. (6) that if the instrument is accurate to 1% of full scale ( $\Delta h = 1$ ), the flow rate error at 50% of maximum flow ( $Q = 50$ ) is:

$$\% F.E. = \frac{(5,000)(1)}{(50)^2} = 2\%$$

## Best Available Equations for Liquid-Liquid, Solid-Liquid Mixtures

## Miscible Liquid-Liquid Mixtures

Eq. No.	Equation	Proponents	Ref.
(31)	$\log \mu_{Lm} = x_1 \log \mu_1 + x_2 \log \mu_2 + x_1 x_2 d$	Grunberg & Nissan	71
(32)	$\log \mu_{Lm} = x_1 \mu_1 \phi_1 + x_2 \mu_2 \phi_2 + 2 \mu_{12} (x_1 x_2 \phi_1 \phi_2)^{0.5}$	Tamura & Kurata	72
(33)	$\ln \mu_{Lm} = x_1^2 \ln \frac{\mu_1 \mu_2}{\mu_{12}^2} + 2x_1 \ln \frac{\mu_{12}}{\mu_2} + \ln \mu_2$	van der Wyk	73
(34)	Nomograph by Davis of $\mu_{Lm} = \mu_{L1}^n$	Arrhenius	74, 75
(35)	$\log \mu_{Lm} = x_1 \log \mu_1 + x_2 \log \mu_2$	Arrhenius	75
(36)	$\mu_{Lm} = (\mu_1)^{x_1} (\mu_2)^{x_2}$	Arrhenius	75
(37)	$\mu_{Lm}^{1/3} = x_1 \mu_1^{1/3} + x_2 \mu_2^{1/3}$	Kendall & Monroe	79
(38)	$1/\mu_{Lm} = (w_1/\mu_1) + (w_2/\mu_2)$ ; For organics	Kern	81
(39)	$\mu_{Lm} = 2 \mu_{water}$ ; For salts in water, <30 wt. %.	Kern	81

## Immiscible Liquid-Liquid Mixtures

(40)	$\mu_{ell}/\mu_c = 1 + 2.5 \phi \left( \frac{\mu_d + 0.4 \mu_c}{\mu_d + \mu_c} \right)$	Taylor	90
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## Liquid-Solid Suspensions

Eq. No.	Equation	Purported Useful Range	Proponents	Ref.
(41)	$\mu_s/\mu_L = (1 + 0.5 \phi_s)/(1 - \phi_s)^2$	$\phi_s < \sim 0.2a$	Einstein	92
(42)	$\mu_s/\mu_L = (1 + 0.5 \phi_s)/(1 - \phi_s)^4$	$\phi_s < 0.1$	Kunitz	93
(43)	$\mu_s/\mu_L = 1 + 4.5 \phi_s$	$\phi_s < 0.4$	Hatschek	94
(44)	$\mu_s/\mu_L = 1/(1 - \phi_s^{1/3})$	$0.5 < \phi_s < 0.9$	Hatschek	95
(45)	$\mu_s/\mu_L = 1 + 2.5 \phi_s + 7.17 \phi_s^2 + 16.2 \phi_s^3$	$\phi_s < 0.35$	Vand	96
(46)	$\mu_s/\mu_L = 1 + 2.5 \phi_s + 10.05 \phi_s^2$	$\phi_s < 0.3$	Manley & Mason	97
(47)	$\mu_s/\mu_L = \left[ 1 + \frac{2.5 \phi_s}{2(1 - 1.35 \phi_s)} \right]^2$	$\phi_s < 0.5$	Eilers	98
(48)	$\mu_s/\mu_L = 10^{1.82 \phi_s/(1 - \phi_s)}$	$\phi_s < \sim 0.4$	Steinour	99
(49)	$\mu_s/\mu_L = \exp [2.5 \phi_s/(1 - 0.61 \phi_s)]$	Conc. susp., spheres	Vand	96

a—When  $\phi_s < 0.04$ , Eq. (41) reduces to this usually seen form:  $\mu_s/\mu_L = 1 + 2.5\phi_s$ .

## How to Estimate Mixture Viscosities

WALLACE R. GAMBILL, Union Carbide Nuclear Co., Oak Ridge, Tenn.

FIRST let's consider miscible liquid-liquid mixtures. If substantial mixture-viscosity data are available, they may be accurately rectified with a method outlined by Doolittle in Ref. 70. When fewer data are known (even as little as one value) you can use one of the three one-constant equations proposed by Grunberg & Nissan, Tamura & Kurata or van der Wyk.

Each of these equations relate  $\mu_{Lm}$  to composition at constant temperature and pressure. Adjustable constants in these equations— $d$  in Eq. (31) and  $\mu_{12}$  in Eqs. (32) and (33)—may be regarded as "interaction viscosities" which vary with temperature according to Eq. (24), *Chem. Eng.*, Feb. 9, 1959, p. 123. These equations have not been

tested and compared sufficiently for us to recommend any one, but each appears to correlate mixture data within a maximum error of  $\sim 10\%$ , even when polar components are present.

Naturally, it's desirable to have enough data to obtain an accurate average value of the adjustable constant.

For 40 salt solutions and four acid solutions, Davis<sup>74</sup> prepared a viscosity-concentration nomograph based on an early Arrhenius relation (see table) in which  $\mu_{Lm}$  is the specific viscosity, referred to water viscosity at the same temperature, of an  $n$  normal solution (for  $0.1 < n < 1.0$ ); and  $\mu_{L1}$  is the specific viscosity of a 1 normal solution.

When you have no mixture-viscosity data at all, you can only make rough estimates of the composition dependency of viscosity. It's not possible, in the general case, to relate mixture viscosity to pure-component viscosities. However, on an empirical basis, two simple equations apply in many cases. Eq. (35) is definitely better than some other simple equations which followed it.<sup>76-78</sup> Eq. (35) may also be written in the form shown in Eq. (36). This equation is probably more widely known than any other of similar type.

For similar, not too polar liquids, the correlation is sometimes quite good, especially at the ends of concentration ranges. It has been shown that mole fraction,  $x$ , is

better in this correlation than either weight or volume fraction. Deviations from such simple additivity, as indicated in Eq. (35) are proportional with real-nonideal mixtures to the energy and entropy of mixing.

Eyring & coworkers<sup>17, 18</sup> concluded that Eq. (35) is the best simple empirical mixture law. However, this writer must choose, instead, Eq. (37) proposed by Kendall & Monroe. Eq. (37) applies to non-electrolytic, non-associated similar liquid pairs. It has been shown<sup>19</sup> to be accurate within 2-3% for oil blends.

Eqs. (35), (36) and (37) are generally most accurate when the component molecular weight and viscosity differences are small, say  $(\mu_1 - \mu_2) \leq 15$  cp. In addition, Kern<sup>20</sup> has proposed some rough rules-of-thumb for heat-transfer applications. For organic liquids in other organics and in water, use Eq. (38). Use Eq. (39) for salts in water where the concentration does not exceed 30 wt. % and where it is known that a sirupy-type of solution does not result.

Other mixture-viscosity rules that have been proposed include Cragoe's<sup>21</sup>, which is especially applicable to oil and which is capable of predicting  $\mu_{1,2}$  greater than either pure-component viscosity. Eight other proposed correlations appear in Refs. 82-89.

Correlations for the viscosity of electrolyte solutions are mostly related to electrical conductivity and are summarized in Ref. 25.

Now let's consider immiscible liquid-liquid mixtures. For this case Taylor based Eq. (40) on theoretical considerations. In Eq. (40) subscript *c* denotes continuous phase, and *d* the dispersed phase;  $\phi$  is the volume fraction of the dispersed phase.

This relation is based on spherical (i. e., small) drops with no surface slip and it should hold for vol. % of dispersed phase  $\leq 3\%$ . For certain applications, Olney & Carlson suggested use of Eq. (35) with volume fractions instead of mole fractions.

### Liquid-Solid Mixtures

Most efforts to correlate suspension viscosity have resulted in relatively simple equations giving  $\mu_s$  in terms of the viscosity of the pure suspending liquid,  $\mu_L$ , and the vol-

umetric concentration of the solid particles,  $\phi_s$ .

In many concentrated suspensions, especially those containing polymers, non-Newtonian effects, such as structural thixotropy, are important; as a result, much of the work in this area has been with fairly dilute suspensions of spherical particles.

Proposed relations pertaining to this case are listed in the table. The writer has compared these nine equations with 12 sets of data from the literature covering a  $\phi_s$  range of 0.0072 to 0.50, and has concluded that though none of these relations are really accurate for  $\phi_s > 0.1$ , Eq. (42) is the best of the lot. Eq. (48) gives results very close to those of Eq. (42).

It also appears that the equations give approximate answers only for solids which are free-flowing when wet (metal powders and glass beads, for example); for other solids, such as clays, chalk, starch and graphite, which are not free-flowing when wet, the viscosities are nearly always larger than those calculated.

However, when we consider the many limiting assumptions on which they are based, Eqs. (42) and (48) are of some value for quick, rough answers if  $\phi_s \leq 0.5$ .

The best method for this case appears to be the recent proposal of Ting & Luebber;<sup>100</sup> but you need density data also to use this method.

Interested readers may find further information and additional correlations (involving arbitrary constants) in Refs. 101-112.

### Miscellany

Though many liquids are Newtonian (water, most pure organics, syrups and many oils), probably even more are non-Newtonian.

A good over-all summary for non-Newtonian liquid mixture viscosity is given by Metzner.<sup>123</sup> The only molecular theory of non-Newtonian flow is Eyring's hyperbolic sine equation,<sup>124</sup> which has been shown to be useful empirically.<sup>125</sup> Later work along this line is reported in Refs. 116-118.

The "bulk viscosity" of liquids is associated with their resistance to volume change under external pressure and has been investigated, among other, by Hirai & Eyring.<sup>126</sup> The viscosity of condensed monomolecular films has been correlated in Ref. 120.

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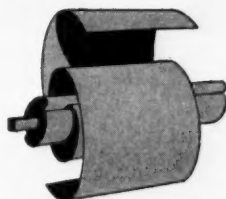
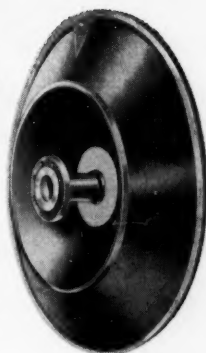
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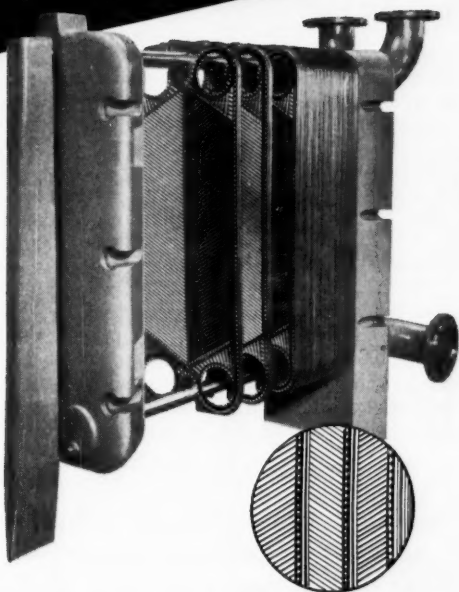
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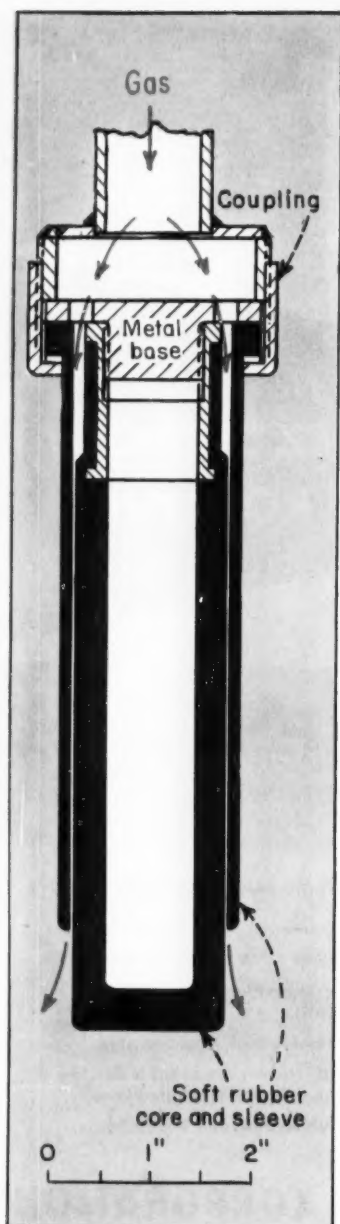
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## Rubber Sparger Averts Clogging by Crystals

Sparging gases into saturated solutions may clog the sparger openings. This nozzle prevents such troubles.

G. B. Hopman, Development Dept., N. V. Mij tot Exploitatie van Kooksoevengassen (Mekog), IJmuiden, Holland.



Sketched here is a design for a combination sparging nozzle and check valve which can solve many problems in the contacting of gases with liquids.

Frequently, in chemical processes, it is necessary to bubble a gas through a column of liquid. In the case of saturated solutions (for example, solutions of a salt or some other readily crystallizable substance) the introduction of the gas often causes difficulty owing to formation of crystals. At the point where the bubbles are formed the three phases of gas, liquid and the solid material of the sparge pipe or other bubble diffuser are in contact in such a way that the solid surface is alternately wet by the liquid and dried by the gas.

The effect of this action is to cover the sparging surface with a layer of salt crystals which will usually block the gas openings in a relatively short time. Usually there are many small orifices to create a large number of small bubbles and complete blocking will sometimes occur within a few minutes.

If the gas can be introduced through a few relatively large openings, then the problem can be averted by building the nozzles from a flexible and elastic material which will move violently and effectively hinder the deposition of solids. This same

approach is not sufficient where small orifices are needed, however. A rubber "shower" will block as easily as similar devices constructed of metals or other solid materials.

I have found that the sparger-check valve illustrated here has a high capacity and gives good distribution of the gas and yet can be kept in operation indefinitely without blocking. This valve has, for example, been used to introduce anhydrous ammonia into a saturated solution of ammonium sulfate, without difficulty.

The valve consists of a hollow, soft-rubber core secured to a metal base and surrounded with a soft-rubber sleeve which fits it loosely and is held to the metal base by a coupling. The latter secures the unit at suitable points to the gas supply piping. Gas flows through several openings in the base and finds its way through the space between the rubber core and the sleeve, causing an ever-changing deformation of the latter. This prevents crystal deposition and effectively distributes the gas. When the gas is shut off, hydrostatic pressure presses the sleeve on to the core and thus completely prevents any backflow of the liquid.

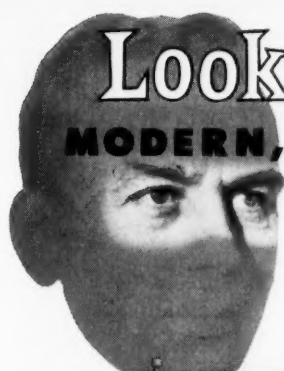
A device of the size shown can handle up to about 900 cu. ft./hr. of gas at low pressure drop.

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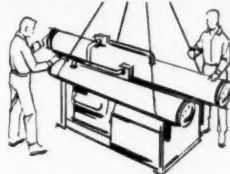
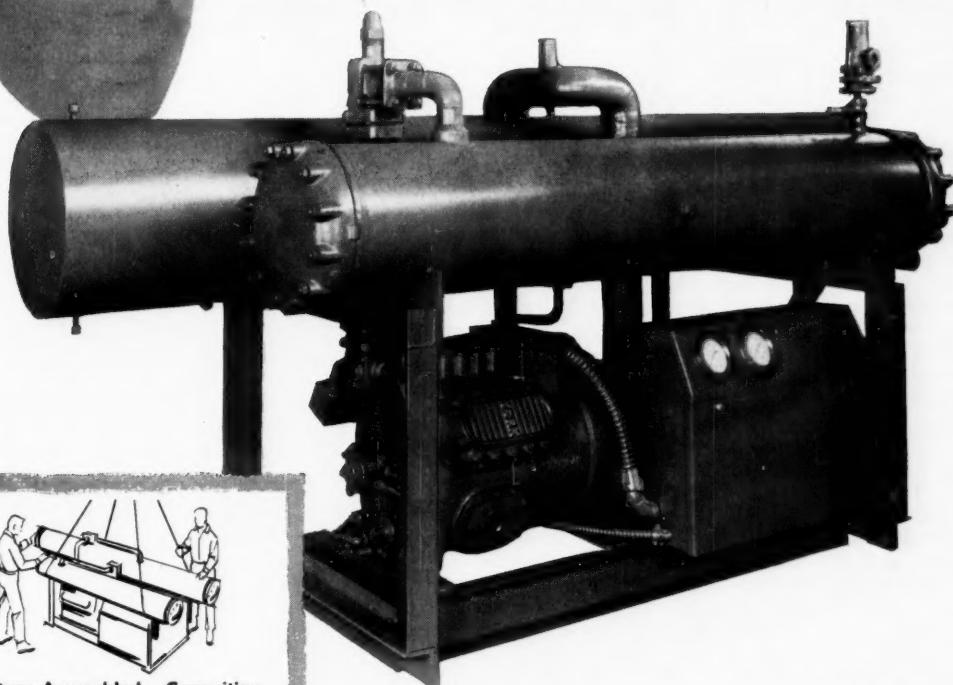
By V. V. Fondrk, Winner of the January Contest

Each four weeks *Chemical Engineering* awards a \$50 prize to the author of the best article submitted to the Plant and Process Design

Notebooks during that period. There is also a \$100 annual prize. Next issue, read Mr. Fondrk's article; also learn the contest rules.

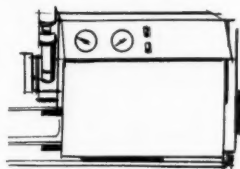


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## Charts Give Full and Partial Capacities of Tanks

Irving Granet, Nuclear Energy Dept., Foster Wheeler Corp., New York.

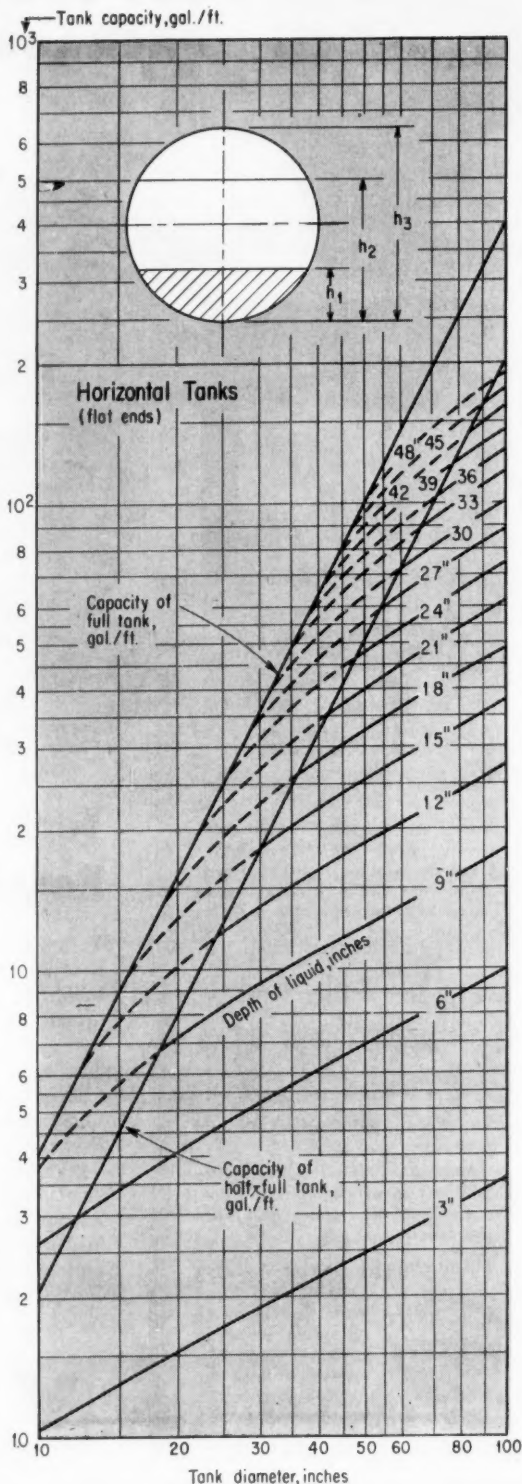
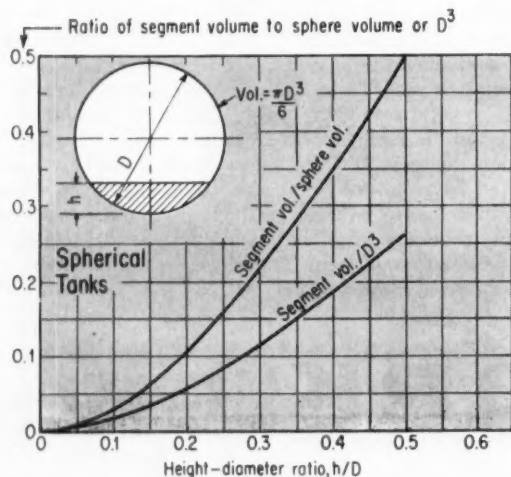
Quick determination of full and partial volume of tanks is the purpose of the accompanying charts. The chart at the right is for horizontal, cylindrical tanks; that below, for spherical tanks.

**Horizontal Tanks**—A tank is 5 ft. in diameter, with flat ends. What is the capacity per foot of length: (a) full; (b) with level 15 in. above bottom; (c) with level 36 in. above bottom?

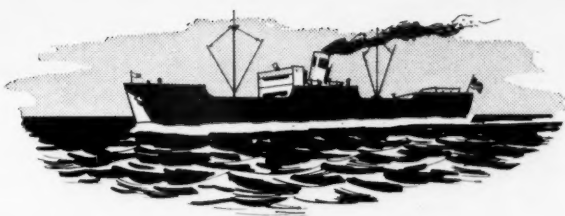
Note in the chart at the right the lines marked "Capacity of full and half-full tanks per foot of length." The lines marked "Depth of liquid, inches" are solid to the right of the half-full curve, and dotted to the left. The accuracy of the solid portions of these curves is somewhat better than the dotted portions so for tanks more than half full it is best to subtract the unfilled portion from the total volume, using the dotted portions as a check. From the full-tank curve capacity is 147 gal./ft.

When the level is at 15 in. ( $h_1$ ) the capacity, from the chart, is 28.7 gal./ft. When the level is at 36 in. ( $h_2$ ), this means an unfilled depth of  $60 - 36 = 24$  in. Since the unfilled volume, by the chart, is 55 gal./ft., and the full tank is 147 gal./ft., then the capacity at  $h_2 = 36$  in. is  $147 - 55 = 92$  gal./ft. The dotted 36-in. curve also shows 92 gal./ft.

**Spherical Tanks**—The chart below is used somewhat differently. For the same depths in a 5-ft. spherical tank, at 15-in. depth,  $h/D = 15/60 = 0.25$ . Then, segment volume/ $D^3 = 0.082$ , or segment volume =  $0.082 \times 60^3 = 17,712$  cu. in. =  $17,712/231 = 76.8$  gal. Where the depth is more than half, i.e., 36 in., subtract the unfilled volume from the full tank volume. Full tank =  $(\pi/6)D^3 = 113,000$  cu. in. Empty segment  $h/D = (60-36)/60 = 0.4$ . Segment volume/ $D^3$  for  $h/D$  of 0.4 = 0.184 from chart so segment volume =  $0.184 \times 60^3 = 39,700$  cu. in. and tank contents is  $113,000 - 39,700 = 73,300$  cu. in. = 317 gal.







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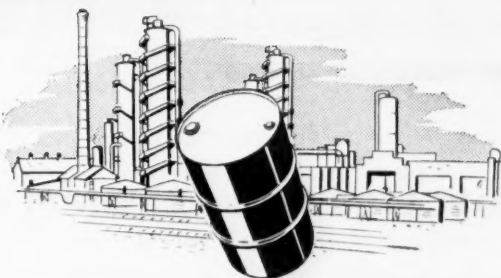
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EDITED BY R. F. FREMED

PRACTICE . . .

## YOU & YOUR JOB

**PROBLEM**—When you bid competitively to supply engineering services or equipment, can you prevent the purchaser from giving your ideas away to your competitor?

**SOLUTION**—Protection may come from a new trend in engineering ethics to forbid competitive bidding on engineering services. In the meantime, here's what our courts have said on this subject.

## How Our Laws Protect Engineering Ideas

Albert Woodruff Gray, Attorney, Forest Hills, N. Y.

Can you stop the unwarranted disclosure of ideas that you include in an engineering contract bid? Yes, I think you can.

Although some of you may feel that this is a matter in the realm of engineering ethics which should never call for legal settlement, individual engineers as well as corporations have come before our courts seeking protection, equity and financial reimbursement for damages.

Recently, I completed some research in this field of law. Let me share some of my findings with you.

Let's first consider the case in which a steel-car manufacturer discovered that plans, blueprints and drawings, that it had furnished to railroads for their aid

and convenience in ascertaining the features of equipment in the preparation of orders, had been given into the possession of a competitor for use in manufacturing the same product.

A Pennsylvania court granted an injunction against such unlawful use and the pirating of the specifications and plans of the car manufacturer, forbidding the use of such material by a competitor.<sup>1</sup> The court said in its decision, "In a great manufacturing community like ours this, or a similar situation, frequently occurs.

"An engineering contracting concern negotiates for the erection of a furnace or a large steel plant, sends the proposed customer blueprints of drawings

which are the results of years of study and experience and have been produced at great expense. An offer is made to construct the plant at a certain price.

"The purchaser sends either the blueprints, or copies of them, to a competing contractor and solicits his bid, thus giving him the benefit of the skill, experience and pecuniary outlay of the other. Sometimes a rival solicits the loan of the blueprints for its own information or for its use in bidding against the one whose designs are acceptable."

To this statement of the facts the Pennsylvania court added, "A certain amount of publicity is inevitable in any manufacture, but an unlocked door is not an invitation to the passer-by or to

# **ALLIS-CHALMERS ACQUIRES S. MORGAN SMITH ... FORMS NEW HYDRAULIC DIVISION**

---

On February 1, the S. Morgan Smith Company became a part of Allis-Chalmers. Extensive A-C facilities in Milwaukee, together with two S. Morgan Smith plants in York, Pennsylvania, are now operating as the newly created Allis-Chalmers Hydraulic Division.

In acquiring S. Morgan Smith, A-C combines its own broad background in hydraulics with the 80 years of diversified engineering and manufacturing knowledge of SMS.

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# **ALLIS-CHALMERS**



*"Ideas, in the protection accorded by the law, follow the pattern of wild and untamed animals of the woods. While held in captivity they remain their owner's property. Once escaped, however, they are the property of whoever captures them."*

the servant of the household to help himself.

"Neither does a manufacturer abandon his property in a design by delivering a copy to another for a restricted purpose, nor by a limited publication. His property rights will be protected in such cases and he will be protected against a breach of trust, confidence or contract."

"Broadly stated," continued the court, "we will not permit anyone to take unfair advantage of a position in which he has been placed through any relation of confidence and trust."

#### Similar to Architect's Plans

"A familiar example is that of an architect's plans. The form of contract used generally throughout the U. S. provides that the plans belonging to the architect shall be returned to him upon the completion of the building."

Concluding its decision, the court said, "The exclusive right to one does not justify another to make and sell photographs. So the exhibition of a blueprint of machinery in a frame in the office of the purchaser, although done by permission of the manufacturer, a copy of whose drawings it is, certainly is not a general publication and an abandonment of exclusive rights in the drawing."

"When this company permitted

its customers to have blueprints it did not give them the right to a use which was not in contemplation of both parties and which would give an unfair advantage to a competitor."

#### Trade Secrets Well Protected

An engineering contract bid might be considered by some to have the same status as a trade secret. Many courts have stated the essential wrong in the disclosure or use of trade secrets entrusted by their owner in confidence to others. See Refs. 2-4; and *Chem. Eng.*, July 28, 1958, p. 127.

However, boundaries have been set up by the courts beyond which this protection does not extend. Unquestionably concrete material, plans, estimates, specifications are granted protection against wrongful exploitation by others in violation of trust and confidence.

Ideas generally, in the protection accorded by law to their owners, follow the pattern of wild and untamed animals. For so long as they are held in captivity and remain in the keeping of their owner, they remain their owner's property. Once escaped, however, they are the property of whoever captures them.

Recently a letter was received by a soap manufacturer which offered, "I have an idea I would

like to sell you about a new kind of laundry soap that would be a sensation and a great godsend to many housewives on washday. A new kind of soap I would call 'blue.'"

The manufacturer replied, "We have been approaching this problem from a slightly different angle in using fluorescent or 'white' dyes in our products. These improved products add to the whiteness of the fabrics and really make the use of bleaching unnecessary."

Several months later the author of the letter sued, contending that the manufacturer had not only used her idea but also appropriated the name, formula and other suggestions she had submitted.

A Federal Court decided that the writer of the letter had no basis for compensation or damages.<sup>5</sup> The court said, "Is there a property right in such a suggestion? If an idea is voluntarily disclosed in an unsolicited communication, may the originator claim that there has been an unlawful appropriation of that idea or of an implied contract to pay for the idea?"

"The general rule of law is that a mere idea is not property and that any right to its exclusive use is lost by its voluntary disclosure."

Much more frequent, however, are instances such as were involved in an action before a Federal court in Connecticut a few years ago. There inventors of electrical equipment had negotiated with a manufacturer for the production and sale by this manufacturer of a steam iron under a license that was given after the application for a patent had been made, but before it had been issued.

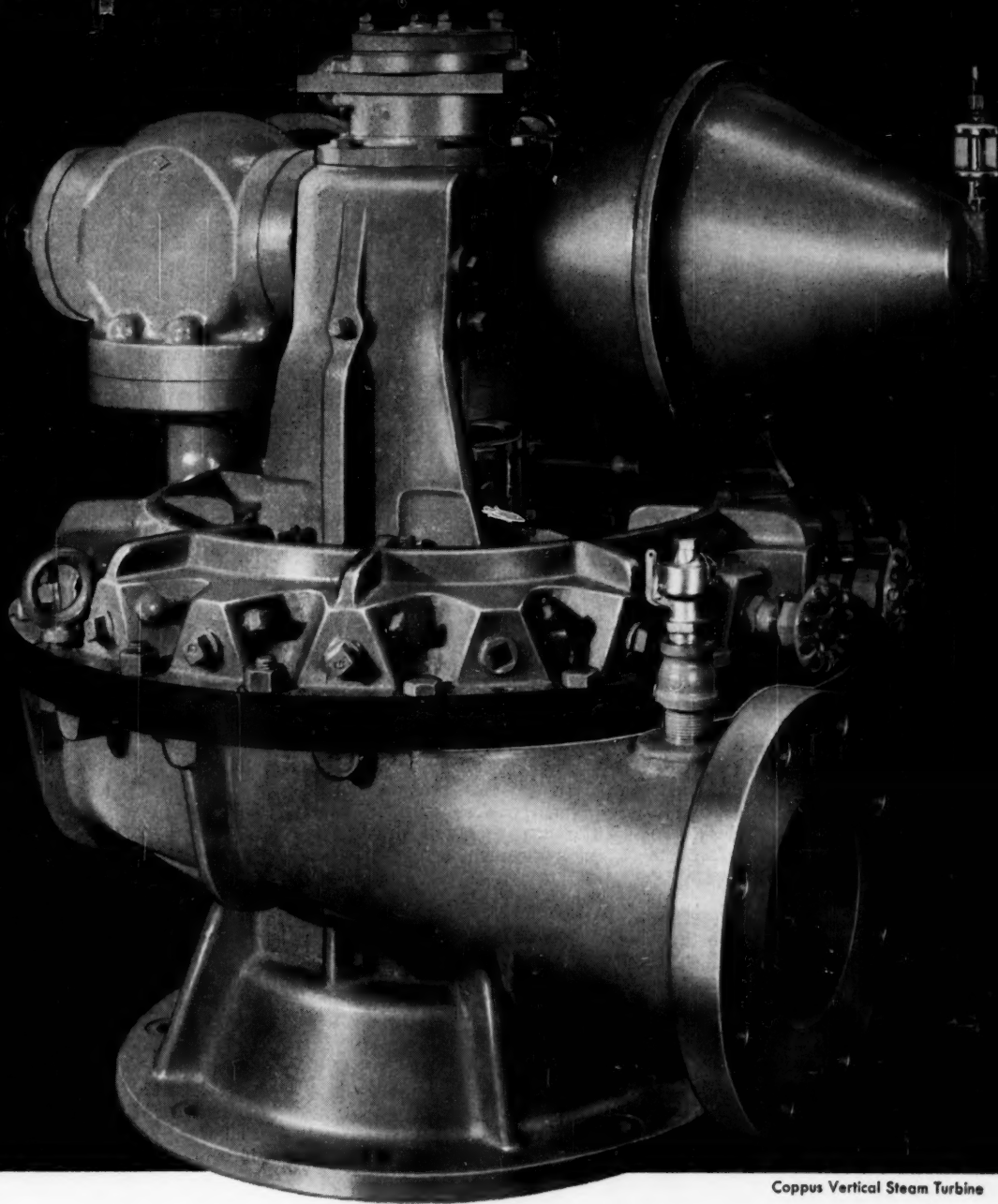
In the course of these negotiations the manufacturer had been furnished by the inventors with blueprints and other detailed information, which it converted to its own use. Sustaining a judgment against the manufacturer for unfair competition, the court said the following:

"Although the court finds no express agreement to hold the information in confidence and not to use it if the negotiations for a license were not successful, there was a confidential relation-



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*"There is a principle of equity that will not permit one to unjustly enrich himself at the expense of another. It would be a reproach to any system of jurisprudence to permit one who has received a disclosure in confidence to appropriate the ideas of another without liability for the wrong."*

ship created between the parties by the disclosures which restricted the right of the manufacturer to use them for the purposes for which the disclosures were made.

"The breach of this confidential relationship, enabling the manufacturer to invade the investor's market, was unfair competition."

#### How to Prevent a Kidnap

The role of the prophet is a hazardous one, particularly in forecasting events in the legal world. Of this hazard Stephen Leacock once wrote, "I have gone out of the prophecy business. Too many people are crowding into it, people without experience. And it is a thing that demands long preparation. Look at those prophets of the Old Testament. They were mature men, 500 to 600 years old, with a bombing range of 3,000 years."

Apparently, however, there exists little or no question of the right of an engineer, in submitting specifications and data in a contract bid, to insist that such information and material be held in confidence by the contractor, irrespective of whether such bids refer to steel railway cars, phosphorus furnaces, heat exchangers or any other subject of engineering skill.

In a decision of a New York

court nearly 75 years ago, a suggestion was made, however, that may avoid for an engineer many anxious hours and legal fees by its observance.

In the case to which we refer a suit had been brought against an insurance company for the use by that company of an advertising system which its author had



ALBERT WOODRUFF GRAY was born in Middletown Springs, Vt. and attended Yale Univ. and New York Law School. He has been engaged in the independent practice of law for more than 20 y s. For four years he served as legal watchdog on advertising copy and radio scripts for the Young & Rubicam advertising agency. Gray is the author of Conover-Mast's "Purchase Law Manual."

communicated to the company as a means to possible employment. When the author failed to secure the hoped-for job, he sued for the value of his idea that he maintained the company had adopted and used.

In its decision—that has since become almost a classic—the New York Court of Appeals said, "Without denying that there may be property in an idea or trade secret or system, it is obvious that its originator or proprietor must himself protect it from escape or disclosure. If it cannot be sold or negotiated or used without a discovery, it would seem proper that some contract should guard or regulate the discovery. Otherwise it must follow the law of ideas and become the acquisition of whoever receives it."

While the circumstances in this case are by no means identical with those in the submission of a contract bid, no disadvantage or injury could occur in the submission of plans accompanied with notice that they are to be received and held in confidence and without disclosure to others.

Such a notice might readily make the protection of the specifications and ideas—the brain children of the engineer—more secure from kidnapping or from piracy.

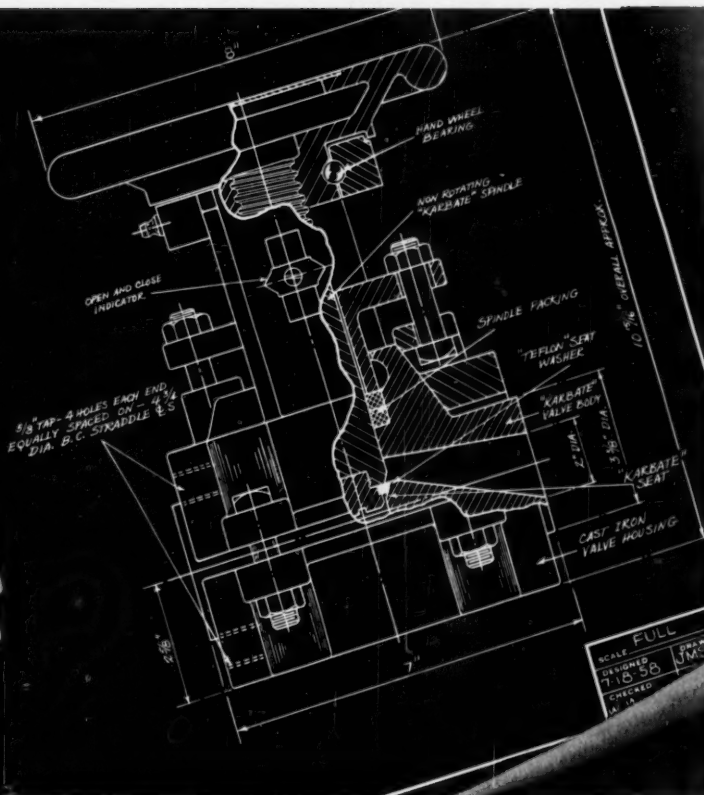
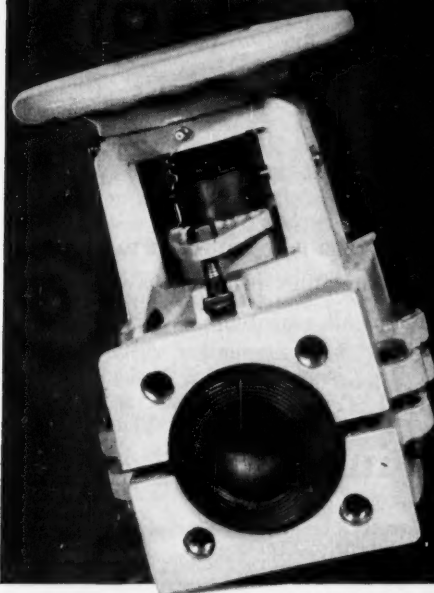
You are well aware of the admonishment, "Let the buyer beware." It would seem that in offering to provide engineering service or equipment you should heed the warning: Let the seller beware, also.

This, of course, is a legal attitude based on the general rule that all's fair in love, business and war. There may also be an interpretation from the point of view of engineering ethics. Should the practice of competitive bidding for supplying engineering services be permitted?

#### REFERENCES

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3. Ferrolite Corp. vs. General Aniline & Film Corp., 207 Fed. 2d 912.
4. Monsanto Chemical Co. vs. Miller, 118 U.S.P.Q. 74.
5. Galanis vs. Proctor & Gamble Corp., 153 F.S. 34.
6. Schreyer vs. Casco Products Corp., 190 Fed. 2d 921.
7. Hoeltke vs. C. M. Kemp Mfg. Co., 80 Fed. 2d 912.
8. Bristol vs. Equitable Life Assurance Society, 30 N. E. 596.

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# "KARBATE" GLOBE VALVE TYPE G

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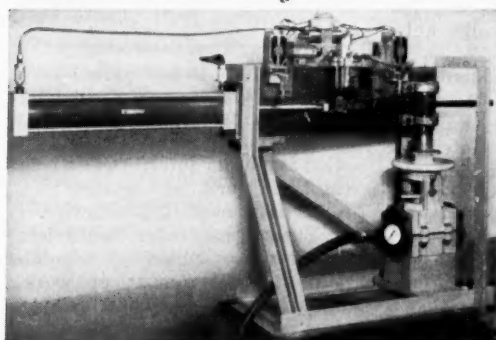


Photo shows test equipment for opening and closing valve to simulate years of actual plant operation. This set-up provided checks on the wearing qualities of spindle threads, sealing qualities of the "Teflon" plastic to carbon seat, and the leak-proof operation of spindle packings.

## Principal design features:

- "Teflon" plastic to carbon seat—provides positive seal when valve is closed.
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- Lubricated ball-bearing handwheel to yolk arrangement—provides easy movement of handwheel with positive lock to yolk.
- Armored design—prevents outside shock damage.
- Positive indication of open and closed positions.
- Valve can be adapted to motor operation.
- Almost universal corrosion resistance—can be used in a wide variety of corrosive chemicals. All wetted parts are "Karbate" impervious graphite or "Teflon" plastic.

Presently, this valve is available in the two inch size. One inch, one and one-half inch, three inch and four inch valves will be added to the line in the future.

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Center

Here's a new approach to your maintenance organization problem: a center to control all maintenance activities.

A New Approach to . . .

## Coordinated Maintenance

LESTER G. STINE, Associated Industrial Consultants, Trenton, N. J.

Unlike production, maintenance is difficult to measure and, in the past, few systems have been devised that really control maintenance costs.

A new approach, the maintenance control center, integrates planning with labor measurement and emphasizes coordinating all maintenance activities. Procedures are specifically directed at uncovering opportunities for labor cost reduction. Established goals of performance are constantly refined and improvement is practically automatic.

This maintenance control center technique is used in several large pulp and paper mills. Results are: Improved maintenance service, less downtime on machinery and reduced labor cost. In one case, a maintenance man-hour reduction of 40% was achieved, saving over \$200,000/year.

Development of a maintenance control center program starts with re-evaluating your over-all maintenance function.

To achieve maximum benefit, you must explore all potential areas for improvement. Developing one phase of improvement, without developing another related phase, never brings lasting

results. For example, individual job standards for hourly men aren't practical unless your foremen and supervisors are trained in the value of planning and scheduling all work.

### Control Center Concept

As the name implies, the principle is to establish a "hub" or center of control for maintenance improvement activity. Physically, the control center is an organizational group related to maintenance the same way industrial engineering and production control are related to production.

In general, maintenance men work at a good pace when they are working. However, because lack of planning, poor coordination and other interferences hold up their work, maintenance men are rarely over 60% effective.

The control center emphasizes organization, planning, scheduling and assignment of work. Maintenance men are delayed less and spend more time working productively.

Another important factor in the organization and planning of maintenance work is coordinating "what is desired" with "what

This article is based on a paper titled "A Maintenance Control Center" delivered at the ASME annual meeting in New York, Nov. 30-Dec. 5, 1958.



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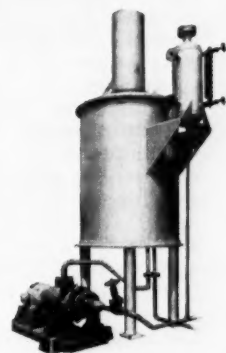
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Daily Work Schedule & Labor Report												
Date: <i>Aug. 4<sup>th</sup></i>		Job Description										
Foreman: <i>B. Terry</i>		Code: <i>32</i>		Inmate Jobs								
Mill and Group: <i>Miller/Grass</i>		Job No. <i>41</i>		Inmate Jobs								
Actual Hrs. <i>→</i>				Inmate Jobs								
Clock	Name	P	A	P	A	P	A	P	A	P	A	P
4792	Anders	1										
4734	Joel	1										
4700	Johnson	1										
4621	Johnson	1										
4633	Simmons	10										
4791	Hoss	1										
4772	Mare	1										
4049	Slick	1										
4001	Stanford	10										
Planned Hours <i>→</i>		4	0	4	0	10	6	16	16	0	0	

is required." Although this factor appears basic and obvious, many production supervisors expect immediate on-the-spot service, even though the maintenance job doesn't require immediate work. Emergency service interrupts planned work and greatly contributes to inefficient use of maintenance labor. Keep a tight rein on your emergency work.

Examples are available of gold-plated maintenance—where considerably more labor is used than required. This usually happens when maintenance supervisors play it safe and carry extra labor for peak load conditions. Most efficient and effective use of maintenance labor places responsibility for coordinating "desired" and "required" with the control center.

This center uses an industrial engineering approach in performing its activities. For example, industrial engineering time-studies a job and arrives at a job standard. Maintenance control gathers data and statistics, merges this with the maintenance foreman's experience and arrives at a job standard.

Obviously, measurement is essential to establish working goals. The control center establishes the goal with the foreman's participation so he's more enthusiastic in seeing the goal achieved.

#### Organization Must Be Neutral

To be most effective and unbiased in its thinking, the maintenance control center is organizationally neutral to the groups it coordinates, plans, schedules and measures. Like industrial en-

gineering, whose members don't report to production, the control center can't be objectively critical of maintenance if it reports to maintenance.

Ideally, a service manager, or other neutral administration within your organization, provides the best over-all direction. If this service manager also has production control responsibilities, coordination of shutdown planning is simplified. Also, interrelationship with industrial engineering adds to the control center's effectiveness in properly doing its job.

Organization of maintenance, to use skills properly and provide the best coverage, is improved by the scheduling and coordinating activities of the center. The control center is responsible for where, when, and what maintenance work is done; maintenance supervision is responsible for why and how it's done.

In a sound maintenance organization, one key factor is effectiveness of personnel. For an over-all improvement program, you should rate all maintenance supervisory personnel. This is best done by evaluating attitudes, morale, skill, and effort through direct observation and personal interview.

Determine weak points so they can be eliminated. Make certain individual talents are used to best advantage in present job responsibilities. In some cases, job transfers are necessary to make the most of individual talents.

Comparing all supervisor's ratings stresses their common strong and weak points.

When a majority of the group is weak in specific areas, a management training program is necessary. End result of supervisory rating and training is developing the most effective and efficient organizational arrangement.

#### Set Policy and Administer It

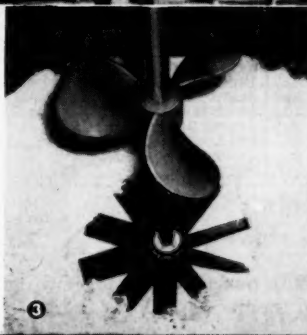
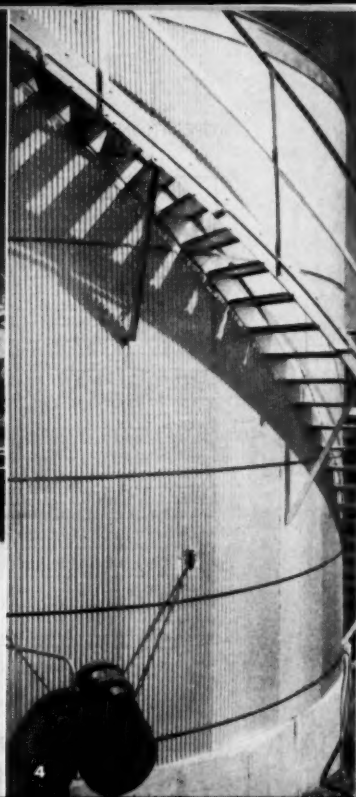
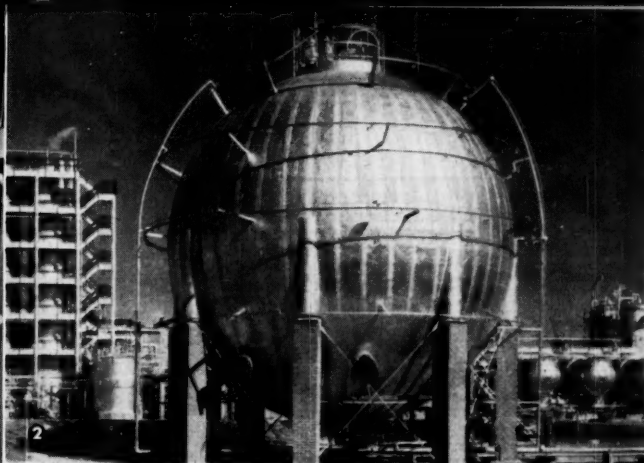
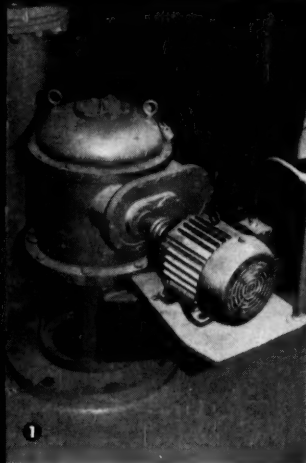
Responsibilities of maintenance supervision isn't usurped by the maintenance control center. Rather, it provides a service that helps supervision do a more effective job. Control center activities are classified as follows:

- Planning: long range; weekly; daily.
- Labor effectiveness improvement: estimate; compare; measure; evaluate.
- Coordination: arrange and prepare for effective work; plan downtime for least interference with production; provide adequate downtime for an effective maintenance job.
- Method improvement: better ways and methods of doing maintenance.
- Clerical: accumulate data for analysis and control; simplify maintenance supervisory paper work; provide adequate cost information.

On the other hand, maintenance management is responsible for supervising and performing maintenance operations, as follows: routine and preventive maintenance; urgent and non-repetitive repair maintenance; construction; salvage; reclaiming materials and equipment; maintenance engineering; materials and equipment improvement.

Study company policy on maintenance to insure fair and equitable practices. For example, first-line supervisors should earn 15 to 20% above their average first-class tradesman; comparable grades within different trade groups should receive equal wages. Establish a formula to determine the number of tradesmen in varying grades (first-class, second-class, third-class, and so on).

Include a formal means of evaluating knowledge in your policy on training and promotion. Written tests for promotion within trade groups is one measure of qualifications. Other



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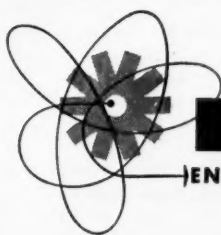
Improved Processing through Engineered Agitation

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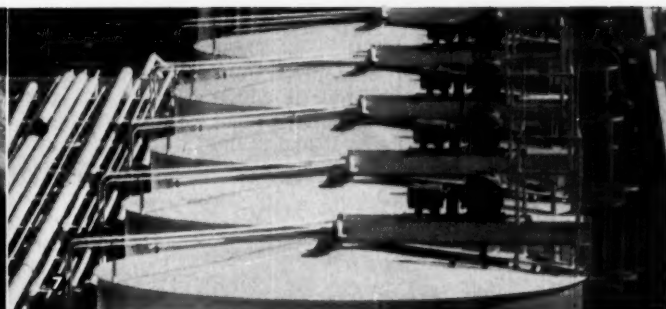
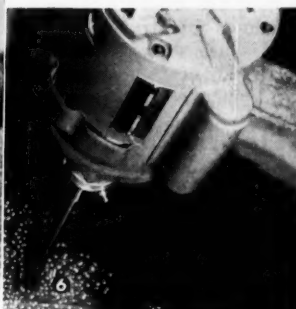
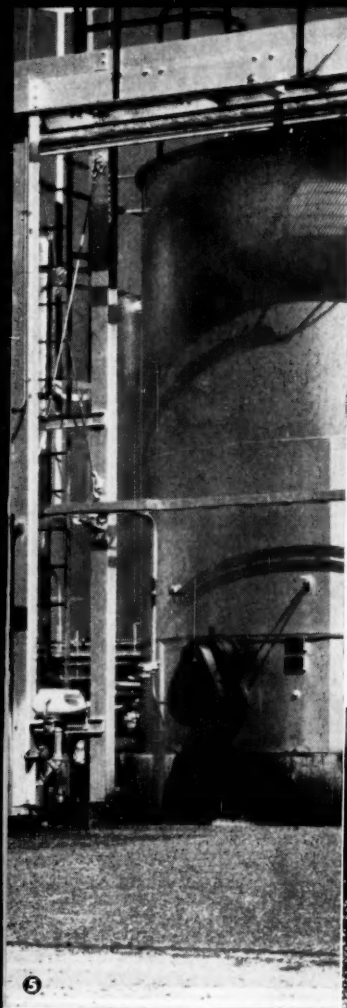
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**NETTCO**  
ENGINEERED AGITATION SPECIALISTS





Dept. <u>No. 1 Paper Mach.</u> Date <u>Sept. 4<sup>th</sup></u>			Est. Downtime <u>5-Hours</u> Actual Downtime <u>4 1/2 Hours</u>		Shutdown Planning Schedule												Sheet <u>1</u> Of <u>1</u>	
Job Assignments			Job No.	Job Description	Job Schedule													
Name	Name	Name			Crew A	Crew B	M/W	Pipers	Elect.									
Brown	Sanders		1	Remove wire, raise couch and lower pressure rolls.	4	1	4											
Shelly	Eager		2	Circulate chemicals	2	1	2											
Brown			3	Wash up wet end section	2	1	2											
Shelly	Eager		4	Hang wire and close up machine	4	1 1/2	6											
Brown	Sanders		5	Remove felts		6	1/4	3										
Shelly	Eager		6	Wash up press section		4	1/2	6										
Able	Rich	Anders	7	Inspect dryer section		2	1/2	3										
Jones	Peters	Baker	8	See dryer felts		6	2	12										
Able	Rich	Anders	9	Hang top and wet felts														
Jones	Peters	Baker		Wash and shrink felts														
				Paper to reel														
Sampson			100	Inspect gear frames and bearings			1	1/2	1/2									
Sampson			111	Inspect drive units and couplings			1	1	1									
	Johnson		3742	Install reel spread bar			2	1	2									
	Shick						2	1	2									
	John						2	1	2									

measures are standard merit rating procedures, and the like.

#### Job-Control Procedure

Formal procedure for planning, scheduling, and coordinating work is essential to maintenance efficiency. The control center accomplishes this by a job-control procedure designed to fit an individual company's needs.

Basically, the control center does the following:

*Justifies the need for the job.*

*Plans and coordinates with production, engineering, and maintenance.*

*Assists maintenance supervision in establishing work schedules, including time estimates for labor.*

*Collects actual labor time and job costs for accounting and management analysis.*

*Analyzes actual performance with planned performance and makes improvement recommendations.*

Essential in this planning program are written work-orders. Verbal orders cause confusion and misinterpretation in both production and maintenance.

The control center receives all requests for work by written work-orders. Serialized job numbers are added to the code. These simplify later cost procedures. Then, the work order is edited for material availability, proper instructions, methods and sound engineering principles.

Economy and real necessity of doing the job is studied. In some cases, it's more economical to buy a fabricated part or assembly or to hire a contractor with more experience than to use maintenance labor. In others, it's necessary to convince the author of the work order there's a better way of getting the result he requested.

Finally, the control center estimates the number of men and man-hours required and schedules the job.

#### Planning Is Important

Daily work planning is essential both in reducing lost time and establishing goals for labor performance. Every day, the maintenance control center meets with each craft supervisor to schedule work for the following day.

Priority is given to over-all production requirements. Considering manpower available, the control center plans enough work to keep crews busy for the following day.

When scheduling, the control center plans work that doesn't affect production (or fill-in work) for two or three men in each crew. These men are used on emergency breakdown jobs if they occur. Otherwise, they work the fill-in jobs consisting of repairs to spare equipment, replacement of spare parts and other general maintenance.

For greatest effectiveness,

performance is evaluated by comparing actual daily time with planned daily time.

One convenient method is using a work schedule and labor report for both planning and collecting actual time spent on each job. In addition, it's a source document for accounting cost distribution. An example of such a report is on the previous page.

#### Shutdown Planning

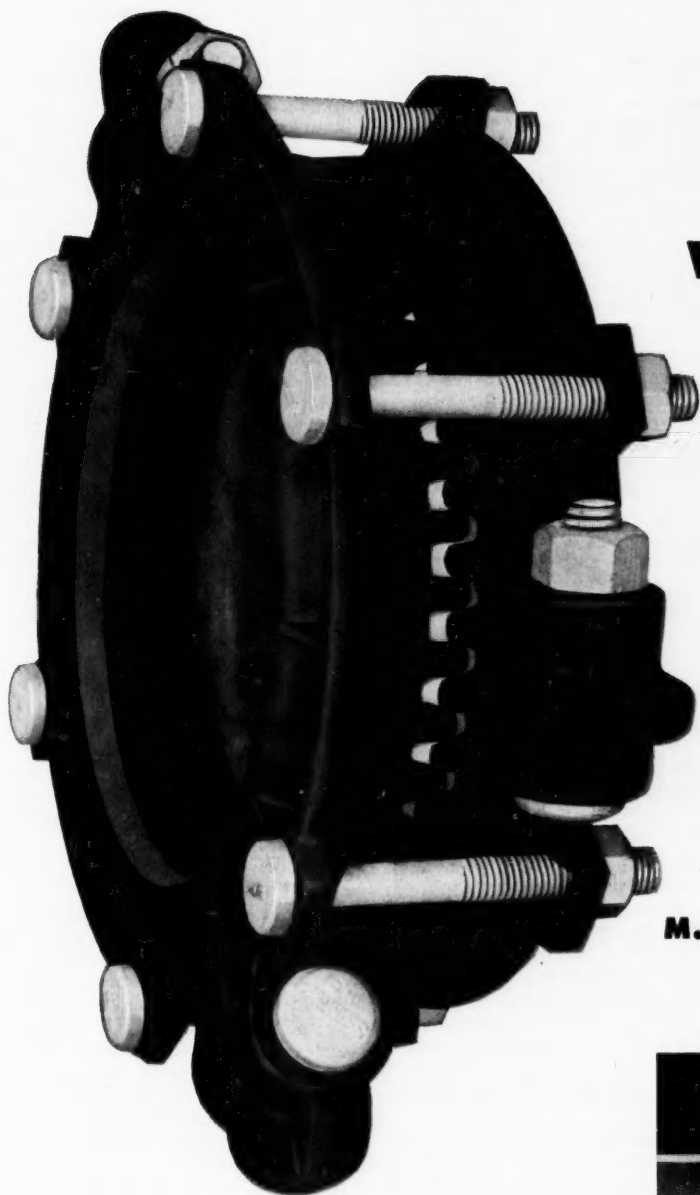
Shutdown planning should be coordinated to keep downtime at a minimum. In the case of process industries, such as paper manufacturing where downtime on one machine can be worth as much as \$500/hr., emphasis on shutdown time is especially necessary.

Coordinating shutdown work is done most effectively by the control center. Typical basic procedures follow:

Shutdown work requests are organized by a convenient listing method. Then, a shutdown coordinating meeting is held with production, maintenance and engineering personnel to determine and agree on what work to do and how long it will take.

Following the meeting, the control center prepares a Ghant Chart shutdown-planning-schedule, as shown above. This identifies specific jobs, planned time schedule, crew assignments and specific men assigned to each job. When production operators do shutdown work, their time is





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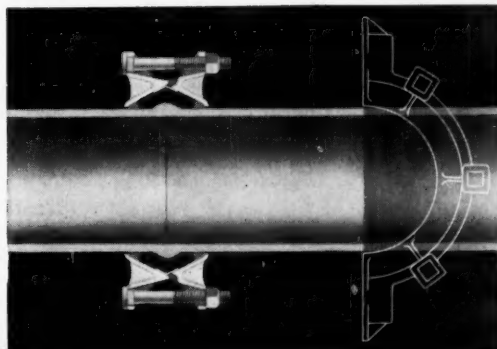
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YEAR



# SKINNER-SEAL

## HIGH PRESSURE WELD CLAMP

planned as well as the time for maintenance personnel.

This schedule is then used to assign men and usually posted in a central location where the work is done.

Each shutdown job is followed by the control center. They record actual time on the schedule. Also, the control center coordinates each working group, through group supervision, to insure the schedule is followed and downtime is held to a minimum.

Following the shutdown, the control center issues a report to group supervisors and others concerned evaluating shutdown performance and recommending methods for future improvement.

#### Long-Range Planning

After operating a shutdown planning program for a year or so, you'll notice production equipment establishing definite trends in so far as maintenance is concerned. By carefully considering past experience and with the equipment manufacturers', production supervisors' and maintenance supervisors' recommendations, the control center is qualified to offer recommendations. This helps set up shutdown dates as long as one year in advance (give or take two weeks) for all production equipment.

Predicting shutdown dates for a year in advance, allows the control center to stagger shutdowns so continuous production suffers the least and maintenance manpower is used most effectively. By only shutting down equipment that's worked on to the greatest advantage by available maintenance people, more work is done with less downtime. This means, equipment is always in an over-all better condition.

#### Chance to Improve Methods

Maintenance work methods, like all productive work requiring labor, provide considerable opportunity for improvement. One major function of the control center is analyzing objectively all methods used and recommending better ways of doing things. Particularly on repetitive jobs, a detailed study of methods invariably reduces time and effort the next time the job is done.

Preventive maintenance, through routine inspection procedures, usually reduces emergency breakdowns. The control center analyzes repeated jobs on the same equipment. Manufacturers are contacted, as well as maintenance supervisors, and a program of routine inspections and adjustments to equipment established.

An inspection card for each type of equipment, such as pumps, motors, cranes, and so on, is made out. These cards are issued regularly and used as check lists for inspections. Adjustments are noted on the card as well as requests for future work. Cards are used to make out work orders and for posting pertinent data to equipment history records.

Lubrication procedures and methods usually permit standardization and offer opportunities for improvement. Constantly, the control center reviews lubrication requirements, maintains proper check lists and assures effective use of oiler personnel. In many cases, the control center evaluates the economics of automatic versus manual oiling.

As a service, to maintenance supervision, the control center evaluates new maintenance tools and equipment. Improved maintenance service and/or cost reduction is the justification for maintenance capital investments.

Many times, maintenance shops are located in obscure plant areas not required for production, with little thought given to efficiency. Cases are available where maintenance men travel thousands of feet from shops to production areas.

Organization of the physical facilities of maintenance is a definite part of a program. Place shops in one central location, close to production, to minimize handling and lost time. To improve communications, centralize the control center. Don't overlook the cost reduction potential of consolidating or reorganizing the maintenance layout.

#### Measure Maintenance Work

There are several yardsticks for maintenance work measurement you can use to show trends and improvement. Particularly

when emphasizing planning techniques, a continuing analysis of effectiveness is desirable.

Planning effectiveness is a measure of what was accomplished compared to what was planned. Daily work schedule and labor reports make it convenient to determine planning effectiveness.

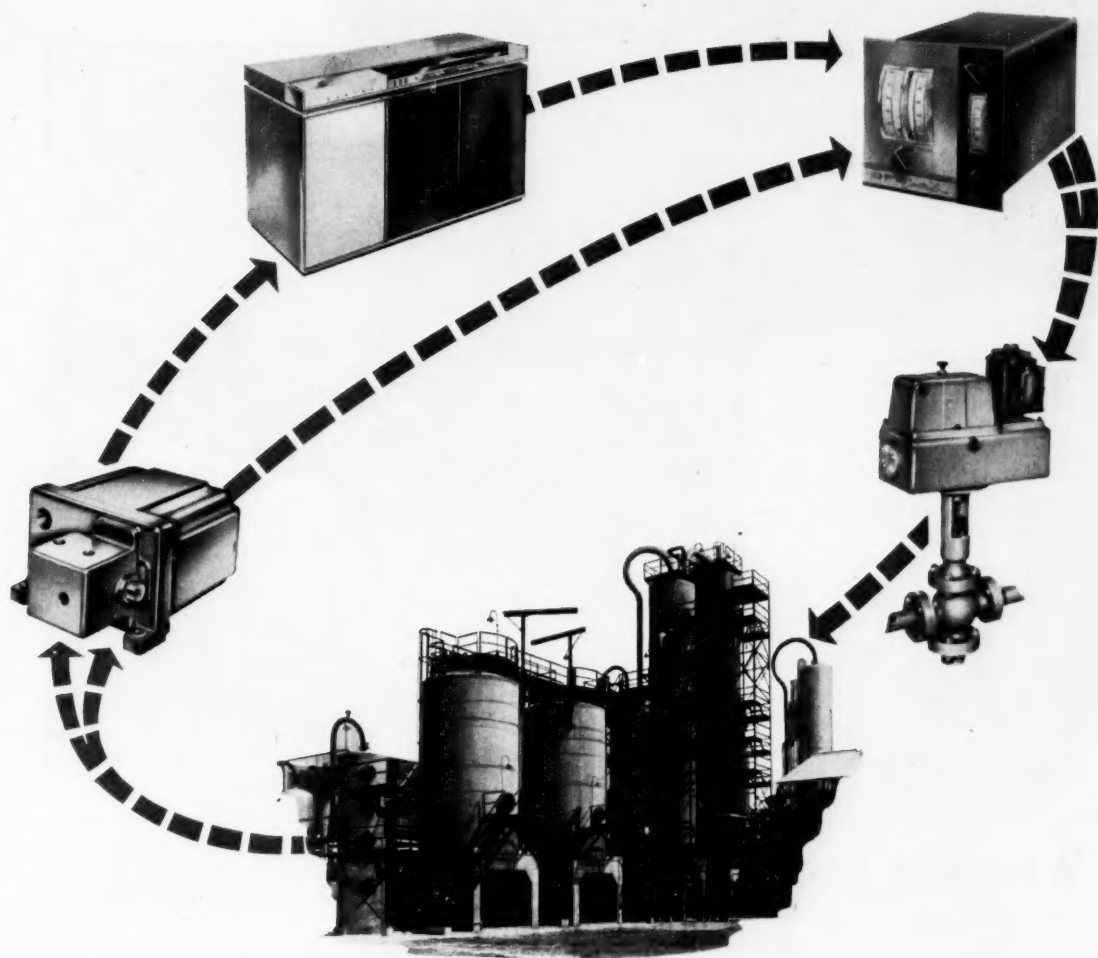
Another essential yardstick of maintenance is labor productivity. For most companies, work sampling is the best method. Basically, this technique involves: First, a definition of the categories of maintenance labor; then, a statistically sound sampling of the work to determine how much time is spent in each category. Here, a bar chart is an effective way of presenting and analyzing data.

Responsibility for establishment and follow-up of work measurement is with the control center. In this phase of activity, the control center performs an important management function in comparing "how long it should take" with "how long it did take."

Incentives, when used properly, are very effective. Use maintenance incentives, like production incentives, only after you've established the best methods for doing work.

Tailor your maintenance incentive program to individual needs. There's no general pattern to follow as a standard. However, it's desirable to develop a number of factors that are a measure of productivity and within control of the men on incentive. Evaluate each factor in detail and weigh it properly in relation to other factors. Administering any incentive plan is one of the control center's responsibilities.

**LESTER G. STINE** holds B.S. degrees in both mechanical and industrial engineering from Penn State. He's a partner of Associated Industrial Consultants and is head of their Maintenance and Systems Division. Stine has specialized in the improvement of maintenance management and has wide experience in continuous process industries such as pulp and paper manufacturing. He's a registered professional engineer in both New Jersey and Pennsylvania.



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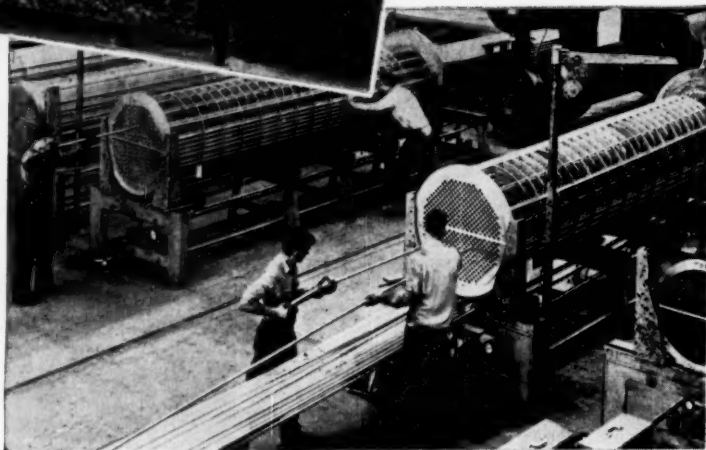
PRACTICE ...

## CORROSION FORUM

EDITED BY R. B. NORDEN

**IMPROVED** fibrous wrought iron has better corrosion resistance and mechanical properties.

**BIG, BOOMING MARKET:** heat exchanger and condenser tubing.



## Wrought Iron Learns New Tricks

Take a good, hard look at this low-cost metal. Recent improvements give a big boost to wrought iron as a material of construction in process plants.

Made more attractive by a recent "facelifting," wrought iron is bidding for new, more difficult jobs in the process industries.

Stainless steels, exotic metals, nickel alloys, etc. have taken the play away from wrought iron until this recent improvement.

Now with better corrosion resistance wrought iron should be given more serious consideration in process design.

► **What Is Wrought Iron?**—Actually what is this metal? First of all there is a basic difference between cast iron and wrought iron. Cast iron contains excess graphite. Wrought iron has no graphite—it's a mixture of highly purified iron and glass-like iron silicate. The silicate is physically entrained in the iron-base material.

To make it, molten iron is poured into liquid iron silicate. Iron droplets form as the stream penetrates the cooler silicate material. These droplets, while forming, entrap gases which build up a pressure finally exploding each drop. Thus the iron becomes impregnated with iron silicate, forming a sponge which is eventually rolled into plates, sheets, bars and pipe.

► **Key: Iron Silicate**—The key to wrought iron's properties turns on this distribution of iron silicate. Because of the silicate, it can be readily bent and formed into coils. It can be formed hot or cold. Welding is done by the usual methods—electric resistance, arc welding, gas or oxyacetylene. Also pipe is easily threaded.

Wrought iron has excellent shock and fatigue properties—much better than cast iron or ductile iron.

And its corrosion resistance, while in the same class, is generally better than carbon steels. The silicate fibers are thought to be the main reason for this. There are about 250,000 silicate fibers in each sq. in. of cross section.

► **Disperses Corrosion**—By dispersing any corrosive attack, these fibers prevent any deep penetration. Also they help anchor any corrosive product to the metal. This gives a dense, tightly adherent iron-oxide scale over the wrought iron surface, protecting the underlying metal. Another benefit: a deep acid etch produces a rough surface. For galvanizing or painting, you couldn't ask for a better anchorage.

► **Improved Iron**—All of these advantages were given a boost with the introduction of A. M.





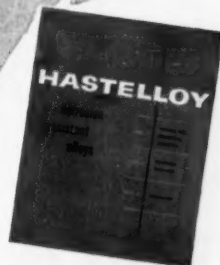
## *Corrosion from boiling mineral acids?*

### **TEST "HAYNES" ALLOYS**

The low corrosion rates on the test specimen indicate the remarkable resistance of HAYNES alloys to mineral acids . . . even at the boiling point. These alloys reduce corrosion damage and product contamination from mineral acids at all temperatures. You will find, too, that they have outstanding resistance to chlorides, halogens, mixed acids, and alkalis.

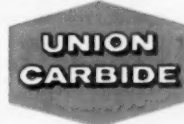
The penetration rates shown on the disks were obtained as a result of laboratory tests. How closely will they match up with data obtained under actual operating conditions? You can find out for sure by testing them.

We'll be glad to send you samples. But to narrow down the number, we suggest you send us a letter outlining your corrosion problem. For full information on HAYNES corrosion-resistant alloys, their properties, forms, the corrosives they will resist, ask for a copy of our 104-page book.

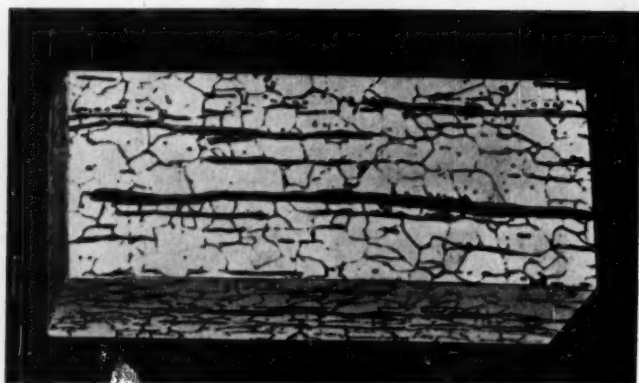


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**HAYNES STELLITE COMPANY**

Division of  
Union Carbide Corporation  
Kokomo, Indiana



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**Fibers in Wrought Iron Halt Corrosion**

Here is why wrought iron stops corrosion. Tiny fibers of glass-like iron silicate slag are threaded throughout the body of the base metal. There are approximately 250,000 of those glass-like fibers in each cross-sectional sq. in. section. This represents 1 to 3%, by weight, of the material. These fibers serve as mechanical barriers which halt and diffuse corrosive attack.

Byers' new 4-D material. Compared to standard wrought iron, this improved metal shows 20% more resistance to industrial atmospheric elements, 25% better resistance in acid and alkali solutions.

Byer metallurgists brought about the improvement by increasing deoxidation of the base metal, adding more phosphorus and using a more siliceous iron silicate.

Take sulfuric acid, for instance. At room temperature the corrosion rate of the new wrought iron in sulfuric acid increases proportionally with acid concentration up to 34%.

Increasing concentration causes the corrosion rate to decrease until, at 61.5 deg. Baume (80%), corrosion rates are moderate (0.02 ipy.).

New wrought iron is highly acceptable for high-concentration sulfuric acid applications. It performs satisfactorily in handling sulfuric acid at concentrations above 80%.

Corrosion rate of wrought iron in sulfuric acid increases at high temperatures, particularly with concentrations where the corrosion rate is rapid (in the 34% range).

► **Against Caustic Soda**—Wrought iron is good against two types of metal deterioration

which are experienced in handling caustic soda:

• **Caustic embrittlement.** This is an intergranular type of stress corrosion. Cracks suddenly develop along the grain boundaries of the metal, with little or no warning. They occur most often on exposure to heated caustic solutions, usually in areas where the metal has been stressed. Crevices where caustic tends to concentrate are also particularly vulnerable areas of attack.

• **Normal corrosion.** This is a loss of metal type deterioration. It is encountered particularly when metal is exposed to caustic soda, interrupted by periods of exposure to air, water or neutral solutions. Severity of corrosion depends on temperature and concentration.

As caustic solutions are heated and/or concentrated, they become increasingly corrosive to ferrous metals. Wrought iron pipe and plate are often used for caustic soda heating tanks and heating coils suspended in caustic solutions.

Tests conducted by one chemical plant compare several ferrous metals in heat exchangers handling caustic soda solutions as high as 50% concentration at a temperature of 140 F. Re-

sults showed wrought iron lasted two to four times longer than other metals.

► **In Heat Exchangers**—Condensers are particularly vulnerable to corrosion because of cooling water handling. In once-through systems the cooling source is often salt water or river water containing quantities of industrial acids and wastes. In a recirculating system, the cooling cycle includes a spray tower which serves to aerate and cool the water. However, the cycle contaminates water with large amounts of dissolved oxygen and—in industrial environments—other corrosive gases such as carbon dioxide and sulphur dioxide.

Either type cooling system presents condenser tubing with a corrosive threat—met with either chemical treatment of water, corrosion-resistant tubing, or both.

Corrosion in tubular air preheaters and economizers of a steam generator are of a different nature. The shell side of these heat exchangers is exposed to combustion gases of sulfur-containing fuels which undergo a sudden drop in temperature. This temperature drop often lowers gases below the dew point, and condensation of water vapor takes place on the tube wall. Tiny droplets of moisture easily dissolve any sulfur dioxide or sulfur trioxide present in the combustion gases and form sulfurous and sulfuric acids which rapidly attack the tube walls.

Performance records show that cold-drawn wrought-iron heat exchanger and condenser tubes are often more durable than many expensive alloys in these applications.

These tubes have performed well in services using refrigerating gases, such as ammonia, carbon dioxide and the freon series.

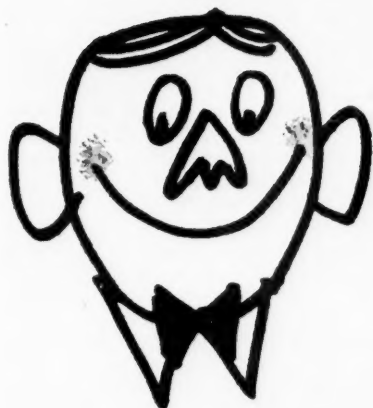
► **Used in Solvay Process**—Wrought iron cold drawn tubing has found application as heat exchanger tubing in the Solvay process. These are eight pass heat exchangers with 92 tubes per pass. Exchangers are approximately 12 ft. long and 9 ft. in diameter.

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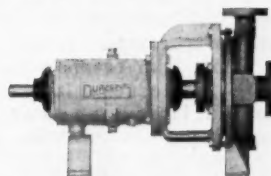
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CHEMICAL ENGINEERING—March 9, 1959

175

## Important Physical Properties of Wrought Iron

### For pipe (ASTM A 72) . . .

Tensile strength, min., psi . . . . .	40,000
Yield point, min., psi . . . . .	24,000
Elongation in 8 in., min., % . . . . .	12

### For plate (ASTM A 42) . . .

Tensile strength, min., psi . . . . .	48,000
Yield strength, min., psi . . . . .	27,000
Elongation in 8 in., min., % . . . . .	14

### And other properties for proper design . . .

Weight per cu. ft . . . . .	480 lb.
Specific gravity . . . . .	7.70
Melting point . . . . .	2,750 F. (approximately)
Mean coefficient of lineal expansion (68 to 200 F.) . . . . .	0.0000741 in./in./deg. F.
Specific heat, room temp . . . . .	0.11
Thermal conductivity, K, (Btu./hr./sq. ft./in./deg. F. difference in temperature . . . . .	(at 64 F.) 417.89 (at 212 F.) 414.99
Shear strength, psi. (room temp.) . . . . .	46,000
Tension modulus, psi. (room temp.) . . . . .	29,500,000
Shear modulus, psi. (room temp.) . . . . .	11,800,000
Poisson's ratio (room temp.) . . . . .	0.30
Hardness:	
Brinell . . . . .	97 to 105
Rockwell . . . . .	B55 to B60
Impact strength—tested at 68 F.:	
(Specimens machined from double refined wrought iron rounds)	
Standard Charpy (Charpy test with keyhole notch) . . . . .	24 to 28 ft.-lb.
Standard Izod (Izod test with Ozod V notch) . . . . .	50 to 60 ft.-lb.
Modified Charpy (Charpy test with Izod V notch) . . . . .	70 to 85 ft.-lb.
Longitudinal specimens machined from plate	
Modified Charpy (Charpy test with Izod V notch) . . . . .	40 to 44 ft.-lb.

shell-side, river water on the tube-side. Brine is composed of about 10% ammonia and salt to the saturation point. It enters the heat exchanger at 50-70 C., and is cooled by the river water to 30-40 C. These wrought iron tubes served for eight years before they were replaced because of failure. Steel tubes had previously failed after only three years from corrosion by the ammoniated brine.

► **Salt Brines**—Like cast iron, wrought iron has a decided advantage over steel in handling hot salt brines. This is indicated by the widespread use of wrought iron pipe and plates in salt evaporators.

Open pan evaporation of brine to produce salt is carried out in large evaporator pans containing heating coils. Many companies have found wrought iron to last much longer than steel in this environment. They use wrought iron plates for the

pans and wrought iron pipe for the coils.

## New Cadmium Coating Prevents H<sub>2</sub> Embrittlement

A low-cost new method for vacuum deposition of cadmium now makes it possible to protect high-tensile steels against corrosion, without danger of hydrogen embrittlement.

Developed jointly by NRC Equipment Corp., Newton, Mass., and its parent National Research Corp., the new method compares favorably to electroplating with respect to process cost and quality of coating. Samples, some of which had been flexed repeatedly, have successfully passed 96 hr. salt spray and salt bath tests without trace of corrosion.

The process is expected to find immediate application in

the aircraft industry for use on parts made of high heat-treat steels, which tend to become embrittled when electroplated. Such parts include landing gear structures, control components, threaded fasteners and other highly stressed elements. As the coating process becomes better known, it will probably be used for automotive products, industrial machinery and a variety of chemical equipment.

NRC Equipment Corp. will supply both process information and vacuum plating equipment to user requirements.

Hydrogen embrittlement and consequent loss of strength results from usual electroplating methods. Acidic components in the plating bath cause the surface layer of high-tensile strength steels to absorb hydrogen. In vacuum coating, of course, no hydrogen is present either from acids or from the air, and embrittlement cannot occur.

The cadmium plating process is related in principle to the well known vacuum metallizing method now used to decorate plastics, die castings and metal stampings. In the decorative metallizing application, a thin but brilliant film, only a few millionths of an inch thick, is applied by vaporizing aluminum inside an evacuated chamber and condensing it on the parts. This is done by hanging a small aluminum staple on tungsten wires which then are heated to incandescence by electrical current.

But the cadmium process differs from this technique. And not only in the vaporized metal but also in the thickness and crystalline structure of the coating. A thin flash film of aluminum is adequate for decoration, but it's too thin to stand up under hard usage unless protected by a lacquer top coat. Thickness of the cadmium coating is on the order of 100 times as great—up to 0.001-in. and more if required.

Also, while the decorative coating appears optically opaque, it contains microscopic passages through which corrosive materials can attack the substrate. In the cadmium process, special techniques are used to produce a hole-free, homogenous coating.





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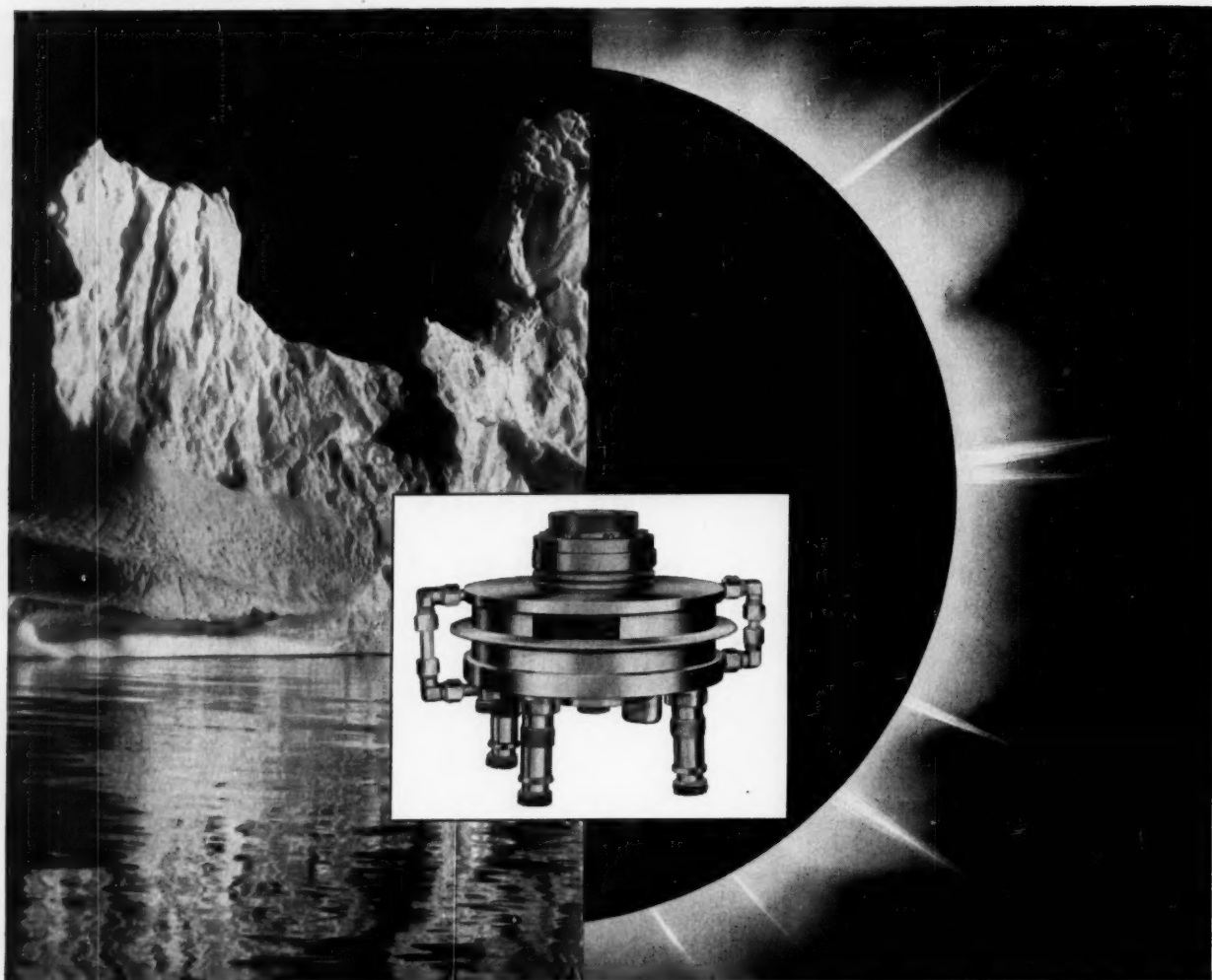
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32°F. The most stable fluid ever developed, the properties of FC 75 have outstanding value in electronics, where it serves as a coolant and insulating fluid. Even under extended use at high voltage FC 75 maintains high dielectric strength. It has wide liquid range, from -148°F. to 212°F., with low viscosity. Nontoxic, non-flammable, it is thermally stable in excess of 800°F. Get all the facts about this "do nothing" chemical. See what FC 75 can do for you.

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**CUTS CORONA CRACKING** Furatone NC-1008, added to neoprene compound ignition cable jackets made by Belden Manufacturing Company, almost eliminates corona cracking, as seen in this comparison of two types of jackets. The new Furatone NC-1008 compound cuts raw materials cost by as much as 8%, reduces scrap waste by 50%, improves processing.



**ROTARY SWITCH SIZE REDUCED!** Plastic rotors, made by Oak Manufacturing Company of KEL-F® halofluorocarbon, made possible the development of a smaller rotary switch only 1 3/8" in diameter. The zero moisture absorption, high dielectric strength, low co-efficient of friction of the KEL-F rotor aided in miniaturization. KEL-F is chemically inert, resists thermal shock, has high impact strength.

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• Inert Liquids and Surfactants.

## FIRMS IN THE NEWS

R. A. LABINE

### NEW FACILITIES

#### March's Top Projects:

**Standard Oil of Ohio** will build a "multimillion-dollar" acrylonitrile plant adjacent to its Lima, Ohio, refinery. Plant, expected to employ 120 workers, is scheduled for completion early next year. Process to be used was developed by Sohio; detailed design and construction will be handled by Badger Mfg. Co.

**Firestone Tire & Rubber** will build world's first commercial plant for Diene (polybutadiene) and Coral (polyisoprene) rubbers. To be located at firm's Orange, Tex., petrochemical center, plant's annual capacity will be 30,000 tons of either product.

**S. C. Johnson & Son** plans to spend \$4 million on new facilities in the next two years: First project will be a new manufacturing plant at Waxdale near Racine, Wis., at firm's warehousing and shipping center.

**Atomic Energy Commission** will join with Carolina-Virginia Nuclear Power Associates in building a 17,000-kw. pressurized-water nuclear power plant at Parr, S. C. Total estimated cost of the project is \$37 million.

**Sunray Mid-Continent Oil** has started construction of a \$600,000 automatic gas products plant near Port Lavaca, Jackson County, Tex. It will process about 30,000 Mcf./day of gas and will turn out about 27,000 gal./day of products.

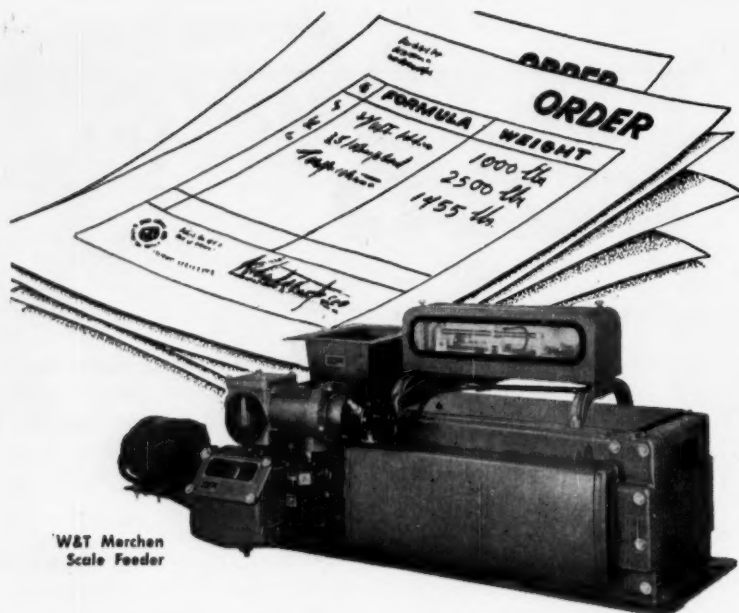
**American Agricultural Chemical Co.** plans to build a sodium tripolyphosphate and tetra-sodium pyrophosphate plant at Carteret, N. J. Unit will utilize phosphorous from firm's extensive phosphate reserves in Florida.

**American Potash & Chemical Corp.'s** new \$4.3-million sodium chlorate plant at Aberdeen, Miss., has gone on stream. Plant is designed for initial production of 15,000 tons/yr. sodium chlorate for the Southern pulp and paper industry.

**Monsanto** is expected to have its new sodium polyphosphate plant at Long Beach, Calif., on stream this month. Principal uses of product are in soap and detergent builders, water softeners and drilling muds.

**Texas Eastern Transmission Corp.** has completed its fractionating plant and railroad loading facilities at the Todhunter, Ohio, terminal enabling transshipment of pipeline LPG to the Northeast in rail cars. New terminal broadens the potential heating markets for LPG.

**Stapan Chemical Co.'s** new plant at Chicago, Ill., for making dimethyl sulfoxide is reported in full production. Firm has a contract to supply a year's requirements of the solvent to Toyo Rayon Co., (Japan)



## IF YOUR PROFITS DEPEND ON WEIGHT...

### *The Best Weigh Is... The Merchen Way*

The connection between profits and weight in industrial operations makes weighing the heart of any process. Reducing waste of materials by accurately weighing and controlling the amount put into your product puts profits in your pocket.

W&T Merchen Scale Feeders accurately and continuously weigh and control the flow of free flowing solid materials to within  $\pm 1\%$  of set feed rate over a 100:1 range. Feed rates from as little as 3 to as much as 3,000 lbs. per minute can be controlled precisely.

Any dry batch blending operation can be made automatic or even continuous by installing W&T Merchen Scale Feeders to provide accurate control of your process... by weight.

For complete information, write to Dept. M-41.29.



**WALLACE & TIERNAN INCORPORATED**

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## PRESSURE SENSITIVE INSTRUMENTS

**Accuracy to 1 part in 1,000**

**Sensitivity to 1 part in 10,000**

**Ranges from absolute zero to 500 psig**

For measuring absolute, differential, vacuum or gage pressure.

For Instrument data and catalog write Dept. A-120.29.



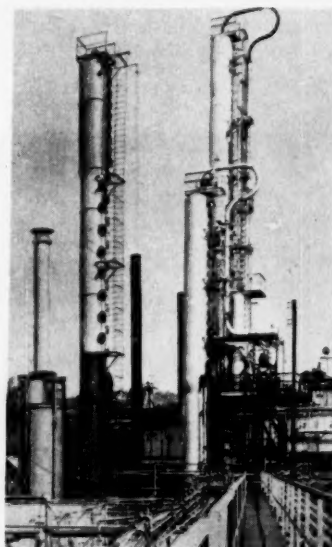
**WALLACE & TIERNAN INCORPORATED**

25 MAIN STREET BELLEVILLE 9, NEW JERSEY

### FIRMS...

for manufacture of a new acrylic fiber using sulfoxide.

Hooker Chemical Corp.'s research staff has moved into its new research center on Grand Island near Niagara Fall, N. Y. Among projects to be carried out in the new facility is research on polyesters, alkyd foams and new exploratory polymer research.



L. Sonneborn's Franklin, Pa., refinery is boasting a new 80-ft. distillation tower, added to meet increased demand for firm's line of specialty solvents.

A. E. Staley Mfg. Co. is building a new 108,000-sq.-ft. research center at its Decatur, Ill., headquarters. To be completed in mid-1960, facility will help assure firm's "profitable diversification and sustained growth."

Collier Carbon & Chemical is expanding its Brea, Calif., ammonia plant by 20%. Firm says that it is improving its competitive position through lowering unit cost of ammonia.

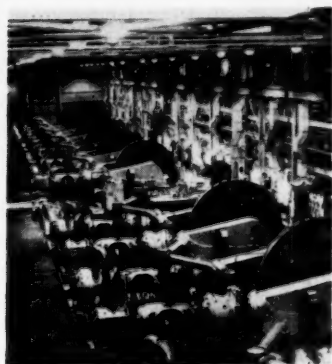
American Cyanamid's Plastics & Resins Div. has a new development laboratory in Wallingford, Conn., in full operation. Unit consolidates



some of the process and product development work formerly carried on at Stamford, Conn., and Bound Brook, N. J.

**Glidden Co.** plans to erect a million-dollar inorganic research and development center at Baltimore, Md., on the site of the firm's Adrian Joyce Works. Facility will concentrate on improving titanium dioxide pigments for paper industry.

**Dow Chemical of Canada, Ltd.**, is moving into western Canada: Engineering has been started on plants for producing caustic soda, chlorine and phenol. Other products under consideration are hydrochloric acid, glycols and plastic foam. Likely site of the caustic-chlorine plant is in Fort Saskatchewan, Alta.; location of the phenol plant has not yet been decided.



**U. S. Government** is going to place the huge Morgantown (W. Va.) Ordnance Works on the auction block on March 19. Built during WW II at a cost of \$63 million, plant was most recently operated by Olin Mathieson for ammonia production, but has been idle for the past year since OM decided the process was not economical. Photo above shows the battery of compressors in the ammonia-methanol synthesis plant.

**Hercules Powder Co.** forecasts employment of 3,000 workers at its new Bacchus, Utah,

# CAMCO

*Quality*

• **FORGED STEEL**

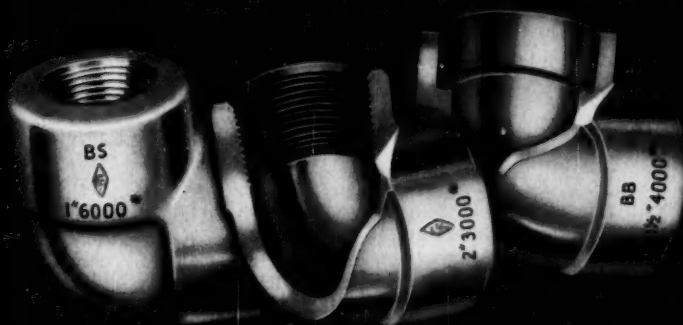
• **ALLOY STEEL**

• **STAINLESS STEEL**

## FITTINGS

2000 Lb., 3000 Lb., 4000 Lb., and 6000 Lb.

**SCREWED and SOCKETWELD**



CAMCO also manufactures a complete line of 150 Lb. Stainless Steel Fittings.

CAMCO FITTINGS, INC.  
North Haven, Connecticut

- ☐ Catalog covering complete line.  
☐ Furnish address of area distributor.

Name .....  
Company .....  
Address .....  
City ..... State .....



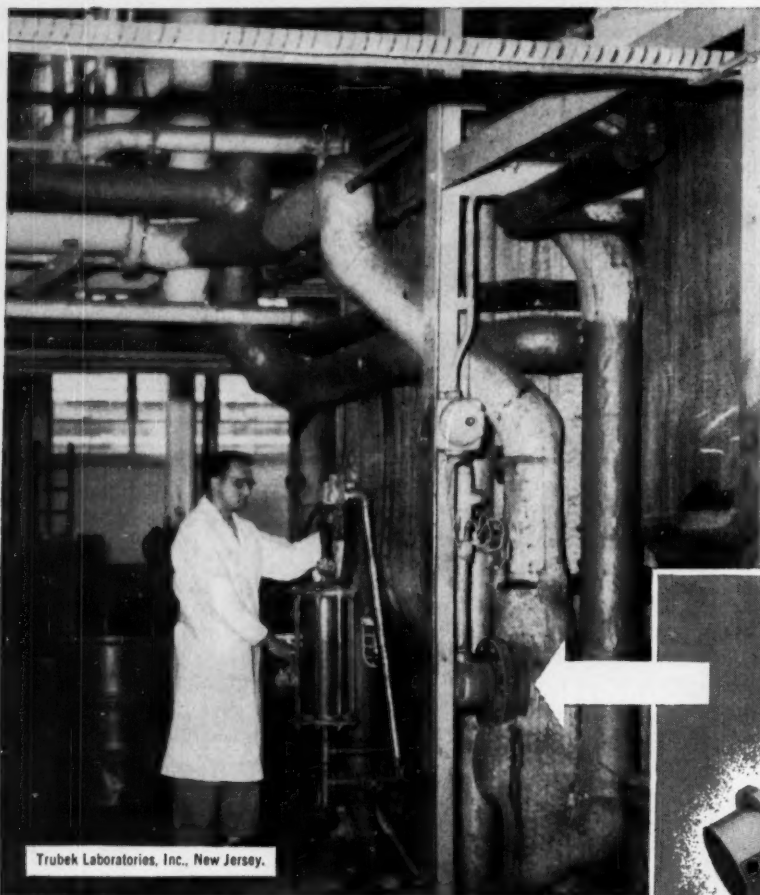
THE *Quality* LINE  
IN FITTINGS

**FITTINGS, INC. North Haven, Conn.**

**WEST COAST AGENT  
AND WAREHOUSE**

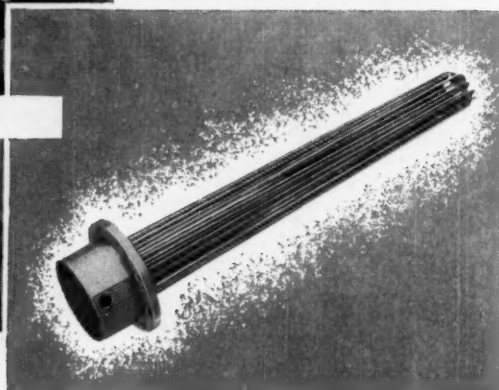
**J. J. GATELY CO.**  
8283 Baldwin Street  
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Call your Chromalox Man for answers to . . .



Trubek Laboratories, Inc., New Jersey.

When temperature requirements could no longer be met by a hot tempering oil central system, Chromalox "job-side" heating provided the answer.



Recently, this New Jersey company converted an old hot-oil central system to Chromalox electric "job-side" heating. In addition to being troublesome, the old system could not provide the variety of temperatures required for their growing diversity of products. Switching to Chromalox Immersion Heaters, they now use Aroclors and Dowtherm as heat transfer media. On one 350-gallon vacuum still, 18kw of heat capacity now provides temperatures of 290°C. Chromalox Type TMO Immersion Heaters operate in the bottom of the vented vessel jacket which contains the heat transfer medium. Using 30kw, a 450-gallon sealed jacket reactor can attain temperatures to 325°C, using Dowtherm-A.

Since some vessels had previously been equipped with steam coils or were glass-lined, insertion of heaters into

the vessel or jacket was impractical. Instead, transfer media is heated adjacent to the vessel and circulated by sump-type centrifugal pump.

Perhaps your Chromalox Man, listed at the right, can help you solve some of *your* heating problems the easy, economical, *electrical* way. Why not give him a call for *Faster heating* of water, oils, Dowtherm, Prestone. *Faster melting* of grease, asphalt, solder, babbitt. *Faster superheating* of steam, compressed air.

4994



CHROMALOX has a complete line of electric heaters to meet all your liquid processing requirements:





## Call Chromalox for the man with the Electrical Answers to your heating problems

**ATLANTA 9, GA.**  
Applebee-Church, Inc.  
1389 Peachtree St., N.E.  
Trinity 5-7244

**BALA-CYNWYD, PA.**  
J. V. Calhoun Company  
349 Montgomery Ave.  
Mohawk 4-6113  
Greenwood 3-4477

**BALTIMORE 18, MD.**  
Paul V. Renoff Company  
333 East 25th St.  
Hopkins 7-3280

**BINGHAMTON, N. Y.**  
R. P. Smith Co., Inc.  
94 Henry St.  
Phone 4-7703

**BLOOMFIELD, N. J.**  
R. L. Faber & Assoc., Inc.  
1246 Broad St.  
Edison 8-6900  
New York: Worth 4-2990

**BOSTON 11, MASS.**  
Leo C. Pelkus & Co., Inc.  
683 Atlantic Ave.  
Liberty 2-1941

**BUFFALO 2, N. Y.**  
Niagara Electric Sales Co.  
505 Delaware Ave.  
Summer 4000

**CHARLOTTE 2, N. C.**  
Ranson, Wallace & Co.  
116½ E. Fourth St.  
Edison 4-4244  
Franklin 5-1044

**CHATTANOOGA 1, TENN.**  
H. R. Miles & Associates  
P. O. Box 172  
Amherst 5-3862

**CHICAGO 6, ILL.**  
Fred I. Tourtelot Company  
407 S. Dearborn St.  
Harrison 7-5464

**CINCINNATI 9, OHIO**  
The Smyser Company  
1046 Delta Ave.  
Trinity 1-0605

**CLEARWATER, FLA.**  
J. J. Galleher  
617-A Cleveland St.  
P. O. Box 1376  
Phone 3-7706

**CLEVELAND 13, OHIO**  
Anderson-Bolds, Inc.  
2012 W. 25th St.  
Prospect 1-7112

**DALLAS 26, TEX.**  
L. R. Ward Company  
3009 Canton St.  
Riverside 1-9004

**DAVENPORT, IOWA**  
Volco Company  
215 Kahl Building  
Phone: 6-5233

**DENVER 2, COLO.**  
E. & M. Equipment Co.  
2415 Fifteenth St.  
Glendale 5-3651  
Genesee 3-0821

**DES MOINES 14, IOWA**  
Midwest Equipment Co.  
of Iowa  
842 Fifth Ave.  
Cherry 3-1203

**DETROIT 34, MICH.**  
Carman Adams, Inc.  
15760 James Couzens Hy.  
University 3-9100

**HOUSTON 3, TEX.**  
H. R. Ward Company  
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Capitol 5-0356

**INDIANAPOLIS 8, IND.**  
Couchman-Conant, Inc.  
1400 N. Illinois St.  
Station A, P. O. Box 88023  
Melrose 5-5313

**KANSAS CITY 5, MO.**  
Fraser D. Moore Co.  
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Victor 2-3306

**LOS ANGELES 15, CAL.**  
Montgomery Brothers  
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Richmond 7-9401

**MIDDLETOWN, CONN.**  
Dittman and Greer, Inc.  
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Diamond 6-9606

**MILWAUKEE 3, WIS.**  
Gordon Hatch Co., Inc.  
531 W. Wisconsin Ave.  
Broadway 1-3021

**MINNEAPOLIS 4, MINN.**  
Volco Company  
831 S. Sixth St.  
Federal 6-3373

**NASHVILLE 4, TENN.**  
H. R. Miles and Associates  
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Cypress 2-7016

**NEW YORK CITY, N. Y.**  
See "Bloomfield, N. J."

**OMAHA 2, NEB.**  
Midwest Equipment Co.  
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Atlantic 7600

**PHILADELPHIA, PA.**  
See "Bala-Cynwyd, Pa."

**PITTSBURGH 8, PA.**  
Woessner-McKnight Co.  
1310 Highland Building  
115 S. Highland Ave.  
Emerson 1-2900

**PORTLAND 9, ORE.**  
Montgomery Brothers  
1632 N.W. Johnson St.  
Capitol 3-4197

**RICHMOND 26, VA.**  
O. M. Thompson  
Westhampton Station  
P. O. Box 8762  
Atlantic 8-8758

**ROCHESTER 4, N. Y.**  
Niagara Electric Sales Co.  
133 Clinton Ave. S.  
Hamilton 6-2070

**ST. LOUIS 1, MO.**  
C. B. Fall Company  
317 N. 11th St.  
Suite 1001  
Chestnut 1-2433

**SAN FRANCISCO 3, CALIF.**  
Montgomery Brothers  
1122 Howard St.  
Underhill 1-3527

**SEATTLE 4, WASH.**  
Montgomery Brothers  
911 Western Ave.  
Main 4-7297

**SYRACUSE 6, N. Y.**  
R. P. Smith Co., Inc.  
2507 James St.  
Howard 3-2748

**WICHITA 2, KAN.**  
Fraser D. Moore Co.  
Room 211 Derby Building  
352 N. Broadway  
Amherst 2-5647

**EXPORT DEPARTMENT**  
1010 Schaft Building  
Philadelphia 2, Pa.

## FIRMS . . .

solid rocket fuel facility "in a few years." Facility is involved in the USAF Minuteman ICBM program as well as "several other proposals" that Hercules has filed with the Defense Dept. Firm has invested \$5 million in the plant to date.

Canada Liquid Air Co. plans to build a \$100,000 plant in Edmonton, Alta., for production of hydrogen. Up to now, Canada Liquid Air has been importing hydrogen from Seattle, Wash.

Naugatuck Chemical, division of U. S. Rubber Co., will conduct research on solid fuels and propellants in a new laboratory just completed at firm's main plant in Naugatuck, Conn.



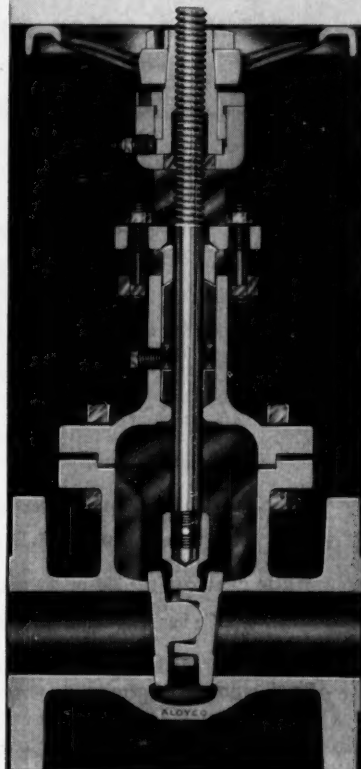
Allis-Chalmers has organized a Nuclear Power Dept. within its recently renamed Atomic Energy Div. New department will be responsible for the division's activities in the nuclear fission field.

Yuba Consolidated Industries now has a new division: Yuba Consolidated Erectors, Inc., which will perform all domestic field erection work for Yuba's heavy steel fabricating divisions.

M. W. Kellogg's specialty alloy steel manufacturing business has been purchased by Firth Sterling for an undisclosed sum. By integrating Kellogg's ingot process with its own steel mill facilities, Firth Sterling now offers structural alloys for aircraft and missiles as well as high-temperature alloys.

Chemetron's Girdler Catalysts is forming a German affiliate to handle its complete line of specialty catalysts in Europe. New firm, headquartered in

## FOR HIGH-PRESSURE CORROSIVE SERVICE:



## 300 lb. Alloyco Stainless Steel Gate Valves

**Figure 2117 double disc.** (above) Available in sizes ½" to 8".  
**Figure 2217** for solid wedge. Sizes ½" to 12".  
In addition—screwed, and socket weld ends. Sizes ½" to 2".  
Other 300 lb. designs including globes,

swing and lift checks; jacketed and tank valves. 600 lb. designs also available.

**Materials**  
Types 304 and 304L  
Types 316 and 316L  
Alloyco 20  
Monel and nickel  
Hastelloy alloys  
B and C

For more information on Alloyco valves for your specific corrosive service, write for Bulletin #7 to Alloy Steel Products Company, 1301 West Elizabeth Ave., Linden, New Jersey...the one manufacturer specializing in Stainless Steel Valves exclusively.

Longer Lasting

**ALOYCO VALVES**

1st IN CORROSIVE SERVICE

**ALLOY STEEL PRODUCTS COMPANY**  
Linden, New Jersey

# DO YOU GENERATE YOUR OWN INERT GASES?

**Using Mathieson CO<sub>2</sub> may be cheaper,  
cleaner, safer and more efficient**

Generators are expensive to buy, operate and maintain while replacement costs are very high.

Use of Mathieson CO<sub>2</sub> eliminates generators and all their associated expense.

Gas generators are slow to get into action . . . very inflexible.

CO<sub>2</sub> is available instantly at all times.

Unless precise metering of fuel is maintained at all times, carbon monoxide may be produced, or all the oxygen may not be consumed.

No metering of fuel required at all. Mathieson CO<sub>2</sub> is uniformly pure at all times.

Produces large amounts of water vapor, necessitating driers.

No water vapor present. No driers needed.

Where inerts are needed under pressure, a compressor must be used.

CO<sub>2</sub> has high vapor pressure at all times.

Reserve storage is a problem in case of stoppages in the generator. Small amounts of generated inerts can be stored, but only as a compressed gas.

Your supply of CO<sub>2</sub> is unaffected by stoppages in equipment or in fuel supply. Large amounts of CO<sub>2</sub> are stored as a liquefied gas.

Sulfur compounds and other contaminants may appear, due to fuel used.

Mathieson CO<sub>2</sub> is uniformly pure at all times.

Gas generators consume valuable floor space.

Use of Mathieson CO<sub>2</sub> requires little floor space or none at all.

Operation may create fumes, dirt, toxic gases.

No fumes, no dirt, no toxic gases.

## HERE ARE SOME OF THE IMPORTANT CHARACTERISTICS OF CO<sub>2</sub> VAPOR

Molecular weight	44.004
Specific gravity	1.527 (when air equals 1) 1.557 (when N <sub>2</sub> equals 1)
Absolute density	0.114 lb./cu. ft. @ 70° F.
Thermal conductivity	0.590 (air equals 1)
Specific heat	0.19 to 0.21 BTU./lb.
Volume, cu. ft./lb.	8.79 @ 70° F.
Pressure, saturated	852.5 psia @ 70° F.
Cost, 100 cu. ft.	\$0.455 (CO <sub>2</sub> costing \$0.04/lb.)

Compare the advantages of Mathieson CO<sub>2</sub> with the problems involved in generating your own inerts by burning out the oxygen in air to arrive at nitrogen plus carbon dioxide. Then contact your Olin Mathieson representative for full details.

5980-A



**MATHIESON CHEMICALS**  
OLIN MATHIESON CHEMICAL CORPORATION  
CHEMICALS DIVISION • BALTIMORE 3, MD.

## FIRMS . . .

Munich, is called Girdler-Suedchemie Katalysator, G.m.b.H.

Kaiser Aluminum & Chemical Corp. and Mexico Refractories Co. of Mexico, Mo., are negotiating for a merger of their respective refractories business. Kaiser is a major supplier of magnesia while Mexico Refractories supplies clay, silica and alumina refractories.

Chemical Economic Services, Princeton, N. J., is now offering custom studies in chemical market research as a new service to the chemical processing industries.



## OVERSEAS BRIEFS

Cowles Chemical Co., Cleveland, Ohio, and the French firm of St. Gobain have built France's first major unit for production of sodium metasilicate, a basic ingredient for synthetic detergents. The \$1-million plant was prompted by the growing popularity of syndets with European housewives.

Korea is getting a new \$23.5-million fertilizer plant, to be built by a consortium of five German firms headed by Lurgi. About 100 German engineers are now on hand preparing construction for the 85,000-ton/yr. unit.

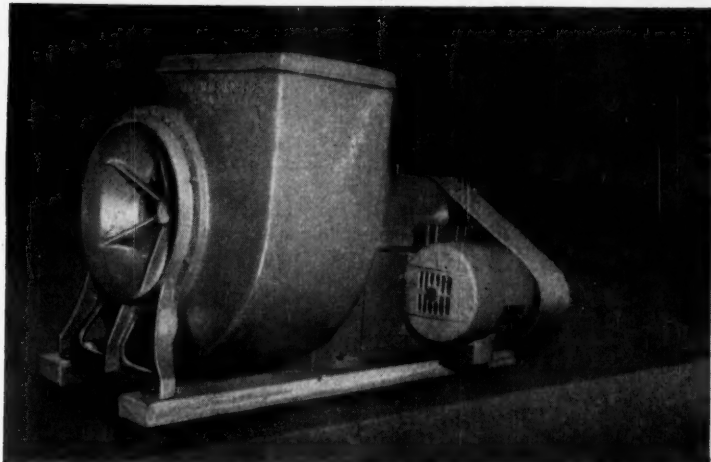
The Shell organization has two new projects on tap: Shell Chemical (Australia) will build a new detergent alkylate plant near Melbourne that will be completed by early 1961. Shell Refining (Philippines) will build a \$19-million, 25,000-bbl./day refinery on Luzon.

Imperial Chemical Industries' new silicon plant at Merseyside, Eng., is now in operation. Unit will be producing at an annual rate of 4,000 lb.

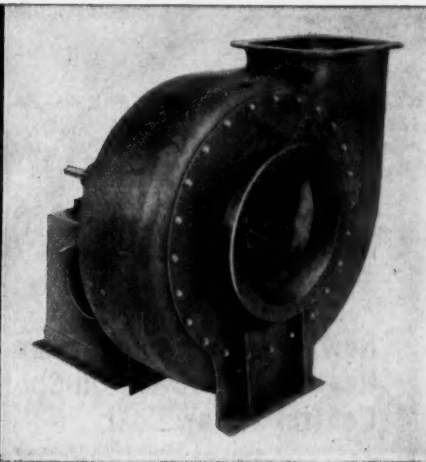


# CORROSIVE FUMES?

**HANDLE THEM WITH THESE SPECIAL "BUFFALO" FANS**



*"Buffalo" Cast Iron Exhauster*



*"Buffalo" Fiber Glass Fume Fan*

"Buffalo" Cast Iron Exhausters are built to withstand extreme corrosive conditions in the chemical process industries. High efficiency is the result of low-turbulence air flow design. This includes heavy-duty cast iron housings and cast inlet cones with integral inlet vanes. Non-overloading characteristics are preserved despite changes in system pressure. Available with direct motor drive, separate belt drive or package unit with adjustable pitch V-belt drive and motor mounted on adjustable base rails. Write us for full information.

"Buffalo" Resin-Bonded Fiber Glass Fume Fans are highly resistant to such chemical corrosives as acids, salts, gases, organic materials and others. They are suitable for temperature applications up to 300° F. The fan housing is constructed entirely of fiber glass. All exposed parts of the factory-balanced rotor are encased in thick fiber glass. Standard capacities range up to 34,000 cfm at pressures to 10" static. Investigate the advantages of "Buffalo" Type "FG" Fume Fans—versatility, lighter weight, reasonable cost, dependability. Write for Bulletin FI-511.

These two specialized fans are representative of the air handling units engineered by the Buffalo Forge Company to help you combat the corrosive fumes encountered in many industrial processes. In addition to these fans, "Buffalo" offers rubber lined fans, fans with other special coatings and a comprehensive line of air cleaning units.

For complete details on "Buffalo" corrosive fume handling units, contact your "Buffalo" engineering representative or write us direct.



**BUFFALO FORGE COMPANY**

**BUFFALO, NEW YORK**

Buffalo Pumps Division, Buffalo, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

VENTILATING • AIR CLEANING • AIR TEMPERING • INDUCED DRAFT • EXHAUSTING • FORCED DRAFT • COOLING • HEATING • PRESSURE BLOWING

# 24-HOUR CONTROL... FOR ONE MINUTE'S PAY!

## New Fulton Sylphon Series 1003 Regulators Provide On-Spot Control at Low Cost

• This new self-powered regulator is trouble-free, powerful and sensitive. Installation is easy and inexpensive. Large Sylphon® Belows provides perfect stroke action for valves up to 4". Handles pressures up to 250 psi. Designed for extra-long life . . . and you can put it on your plant's "payroll" for round-the-clock control at a daily cost less than your average employee's pay for one minute.

**NEW**  
at no  
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- Teflon Chevron lifetime valve stem packing — no service needed
- Monel valve stem super-finished to prevent sticking
- "Quick-Detach" stem fitting for easy valve removal
- Single-seated "MA" valve for "dead end" service
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GET THE FULL STORY OF LOW-COST TEMPERATURE  
CONTROL IN BULLETIN D-EC



**Robertshaw-Fulton**

CONTROLS COMPANY

FULTON SYLPHON DIVISION • Knoxville 1, Tenn.

## FIRMS . . .

by mid-year; most of production goes into transistors.

**India** plans to build its first big plant for heavy industrial organic chemicals, costing \$25-35 million and employing over 1,000 workers. No decision has been made yet on location; Indian government is currently negotiating for German credit.

**Phoenix-Rheinrohr, A.G.**, of Dusseldorf, West Germany, one of West Europe's largest steel and pipe manufacturers, is expanding its line to include fiber-glass-reinforced plastic sheets and molded products. Firm already manufactures plastic tubing.

**West German** consortium made up of Badische Anilin-und-Soda Fabrik, Uhde, GmbH, and CITRA, has signed a contract in Cairo for the erection of the final unit in the United Arab Republic's Aswan nitrogen fertilizer plant. Unit will boost ammonium nitrate production by 100,000 tons/yr.

**Holland's** Royal Sulphuric Acid Works is setting up a new company, Ketjen Carbon, Ltd., to manufacture carbon black in the Netherlands. New firm has a licensing agreement with Godfrey L. Cabot, Inc., for use of the latter's patents and know-how.



**Fulton Bag & Cotton Mills** has changed its name to Fulton Cotton Mills, Inc., to establish itself more clearly as a primary source of cotton for fabrics.

**Perkin-Elmer Corp.'s** Engineering & Optical Div. is now called the Electro-Optical Div. Division produces missile range instrumentation, infrared systems, precision optics and other electronic-optical systems.

New steels are  
born at  
Armco

### CREEP AND SHORT TIME YIELD STRENGTHS AT ELEVATED TEMPERATURES, PSI

	°F	75	600	700	800	900	1000	1200	1350	1500	1600
Armco 17-4 PH Cond. H900	0.2% Y. S.	186,000	150,000	146,000	141,000	132,000	74,500	43,000	—	—	—
	0.1% Creep in 1000 hrs.	—	105,000	80,000	—	—	—	—	—	—	—
Armco PH 15-7 Mo Cond. RH950	0.2% Y. S.	220,000	178,000	165,000	152,000	132,000	105,000	—	—	—	—
	0.1% Creep in 1000 hrs.	—	150,000	143,000	108,000	44,000	—	—	—	—	—
Armco 17-14 CuMo Heat Treated	0.2% Y. S.	41,000	29,000	—	—	—	26,000	26,000	24,000	21,000	13,000
	0.1% Creep in 1000 hrs.	—	—	—	—	—	—	24,000	16,000	11,000	—
Armco 22-4-9 Heat Treated	0.2% Y. S.	102,000	—	—	—	58,000	56,000	48,000	40,000	31,000	25,000

## GET TROUBLE-FREE HIGH TEMPERATURE BOLTING with Armco's Special Stainless Steels

These elevated-temperature properties of Armco 17-4 PH, PH 15-7 Mo, 17-14 Cu Mo and 22-4-9 briefly but graphically demonstrate the utility of these special stainless steels for bolting as well as parts of mechanical and processing equipment that must withstand heat, high stresses and corrosion.

In addition to their desirable mechanical properties, Armco's Special Stainless Steels provide a useful range of design advantages such as high "hot" hardness, a choice of coefficients of thermal expansion and good fabricating characteristics.

Get more information on these economical Armco grades and evaluate their usefulness in solving material problems

imposed by high heat and pressure. Just fill out and mail the coupon.

ARMCO STEEL CORPORATION, 1519 Curtis St., Middletown, Ohio

Send me  
Product Data Bulletins on

- ☐ Armco 17-4 PH Stainless  
☐ Armco PH 15-7 Mo Stainless  
☐ Armco 17-14 Cu Mo Stainless  
☐ Armco 22-4-9 Stainless

We are considering it for \_\_\_\_\_

NAME \_\_\_\_\_

FIRM \_\_\_\_\_

STREET \_\_\_\_\_

CITY \_\_\_\_\_

ZONE \_\_\_\_\_

STATE \_\_\_\_\_

## ARMCO STEEL

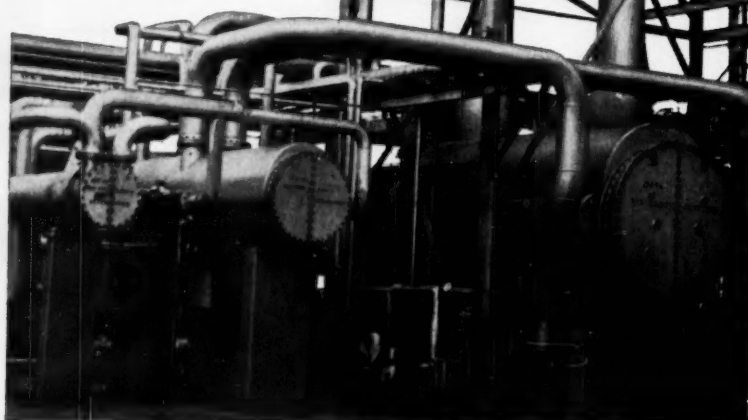


Armco Division • Sheffield Division • The National Supply Company • Armco Drainage & Metal Products, Inc. • The Armco International Corporation • Union Wire Rope Corporation • Southwest Steel Products

## ANOTHER ELLIOTT EJECTOR

**...engineered  
for the job**

The twin, three-stage Elliott steam jet ejector seen here maintains a suction pressure of 5mm Hg absolute



### *designed to serve world's largest crude oil unit*

This unique, giant-sized ejector is the largest vacuum installation ever built. The design problem here was to engineer a unit which would efficiently and economically maintain the specific suction pressure required by the application. To accomplish this, Elliott engineers designed a twin-type ejector with two vertical first-stages which are 40 ft long, have 60-inch diameter inlets, and discharge to a 20,000-sq ft intercondenser. The two 20-inch second-stage ejectors discharge to a 6000-sq ft intercondenser and the third-stage ejectors discharge to a 3000-sq ft aftercondenser.

#### *write us for descriptive bulletins*

Available literature on single-stage, multistage and corrosion-resisting types illustrate Elliott's versatility in ejector design and construction for all sorts of

chemical and industrial process applications. Contact your nearby Elliott District Office or write Elliott Company, Jeannette, Pa.

**ELLIOTT**  
Company 

Send for  
complete  
details  
today

GE-2



## CALENDAR

**American Institute of Chemical Engineers**, national meeting, Chalfonte-Haddon Hall Hotel.  
March 15-18 Atlantic City, N. J.

**American Society of Mechanical Engineers**, annual spring conference of Lubrication Div., Franklin Institute.  
March 16-17 Philadelphia, Pa.

**National Assn. of Corrosion Engineers**, annual meeting and exhibition, Sherman Hotel.  
March 16-20 Chicago, Ill.

**American Society for Metals**, 11th Western Metals Exposition and Congress, Pan-Pacific Auditorium and Ambassador Hotel.  
March 16-20 Los Angeles, Calif.

**Textile Research Institute**, annual meeting, Commodore Hotel.  
March 23-24 New York, N. Y.

**American Society of Mechanical Engineers**, Instruments and Regulators Division Conference, Case Institute of Technology.  
March 29-April 2 Cleveland, Ohio

**American Physical Society**, annual meeting.  
March 30-April 2 Cambridge, Mass.

**American Institute of Chemical Engineers**, Philadelphia-Wilmington Sections, Symposium: Experience in Industry, University of Pennsylvania.  
March 31 Philadelphia, Pa.

**Pharmaceutical Manufacturers Association**, annual meeting, Boca Raton Club.  
April 1-3 Boca Raton, Fla.

**American Institute of Mining, Metallurgical and Petroleum Engineers**, Technical Conference: Stress Corrosion, Mellon Institute.  
April 2-3 Pittsburgh, Pa.

**American Chemical Society**, annual national meeting.  
April 5-10 Boston, Mass.

**Nuclear Congress**, coordinated by the Engineers Joint Council, Public Auditorium.  
April 5-10 Cleveland, Ohio

**Instrument Society of America**, Second National Symposium on Chemical and Petroleum Instrumentation.  
April 6-7 St. Louis, Mo.

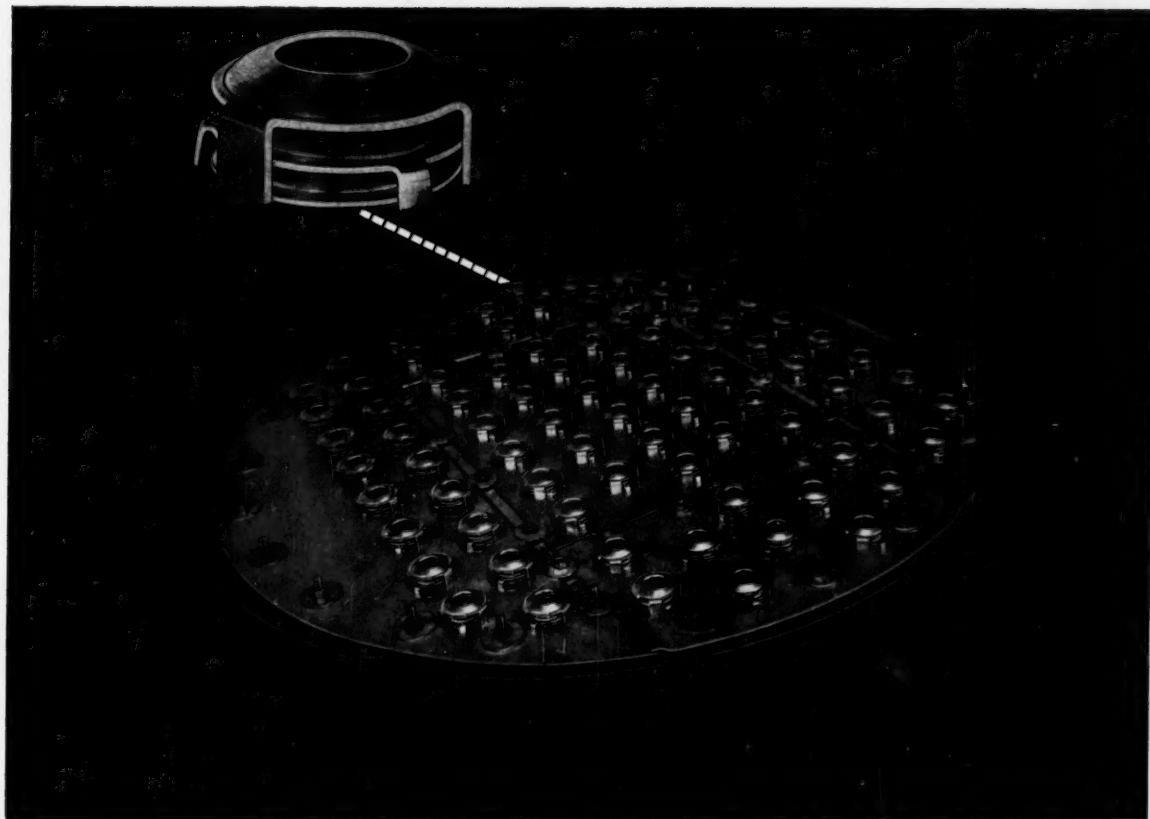
**American Institute of Mining, Metallurgical and Petroleum Engineers**, 42nd national Open Hearth Steel Conference and Raw Material Conference, Jefferson Hotel.  
April 6-8 St. Louis, Mo.

**American Institute of Chemical Engineers**, Ohio, Pittsburgh and West Virginia Sections, annual symposium: Catalysis, Mellon Institute.  
April 10 Pittsburgh, Pa.

**Engineering, Marine Welding and Nuclear Energy Exhibition**.  
April 16-30 Olympia, England

**American Oil Chemists Society**, 50th Anniversary Meeting, Roosevelt Hotel.  
April 20-22 New Orleans, La.





## Something NEW...in Valve Tray Design

**OPERATING DATA REVEALS GLITSCH BALLAST TRAYS GIVE GREATER TURNDOWN RATIO — OVER-ALL OPERATING EFFICIENCY**

The Glitsch Ballast Tray is a new type valve tray that has all the good features both of conventional bubble cap trays and perforated trays, and yet eliminates the many inherent problems encountered with ordinary valve type trays.

Data secured during operational runs to determine the efficiency of the new Glitsch Ballast Tray established the following: (1) The efficiency of the tray from very low vapor rates (within ten per cent of flood point) up to moderate vapor rates is higher than any other tray of comparable capacity; (2) the turndown ratio of the Glitsch Ballast Tray (the ratio of maximum to minimum vapor rates at which a high efficiency is maintained) is at least 9.0.

The Glitsch ballast unit is designed to function as a

variable orifice and thereby provide a staging of the vapor through the various rates of flow. This design permits uniform distribution of vapor through the liquid throughout a wide range of capacity; optimum vapor velocity through the liquid over a wide range of flow rates; large turndown ratio by progressive staging of the vapor opening from low to increasingly high fluid rates, and establishes a primary pressure drop at the vapor-liquid interface to obtain maximum tray efficiency.

Increase the efficiency of your next distillation units. Specify new Glitsch Ballast Trays. For more information and operating data on the ballast tray, contact your nearest Glitsch sales representative or Glitsch — Dallas, Texas.

*Specify Glitsch TRUSS-TYPE® Trays*

**Fritz W. Glitsch & Sons, Inc.**  
4900 SINGLETON BLVD. | DALLAS 2, TEXAS



SALES OFFICES: New York • Cleveland • Los Angeles • Tulsa • Dallas • Houston • Baton Rouge • Uxbridge & Sarnia, Ontario, Canada

CHEMICAL ENGINEERING—March 9, 1959

189

# Are Entrainment Losses Stealing Your Profits?



GET  
THESE  
NOW!



## Centrifix®

SCRUBBERS • PURIFIERS • SEPARATORS

### Increase Your Profits!

1. Increases efficiency of existing equipment—get more production PLUS valuable by-products that help pay for this improvement.
2. Removes 99.5% or more of ALL solid or liquid entrainment in gas, air, steam or vapor regardless of density, chemical characteristics or size (even 1 micron or smaller).
3. Protects valuable capital equipment from costly shut-downs and major overhaul.
4. Reduces maintenance cost—no moving parts, no filters, non-clogging, self-cleaning.
5. Operates with MINIMUM pressure drop regardless of pressure, temperature or flow rate.
6. Easy to install—saves space, low cost.

AA-5248



**Centrifix®**  
**CORPORATION**

3608 PAYNE AVENUE  
CLEVELAND 14, OHIO

All Centrifix equipment is protected by U. S. Letters Patent & Patents Pending

#### NEW EQUIPMENT . . .

(Continued from p. 106)

the manufacturer. Each 5-lb. pallet, which is made of wood-reinforced corrugated paper-board, can carry 31 to 36 sacks of cement (or equivalent) weighing 94 lb. each.

Changeover should greatly increase freight savings and payload by eliminating the large dead weight of wooden pallets. Also eliminated will be expenses for pallet repairs and sack breakage caused by splinters and nails. Each expendable pallet will cost considerably less than \$1.00.—Calaveras Cement Co., San Francisco, Calif. 106D

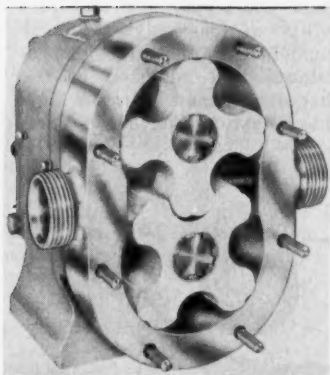


#### Gas Flowmeter

An electrical device for hazardous areas.

An electrical gas flowmeter calibrated for true mass flow has just received approval of Underwriter's Laboratories for use in Class I, Group D hazardous areas. Chief features making the flowmeter safe are that voltage is limited to a fraction of a volt, and current to a fraction of an ampere. Resulting temperature rise on the thermal element under no conditions exceeds 31 C.

In operation, gas flow is measured directly, with no need for temperature and pressure corrections. A linear scale on the indicator reads 0—200; calibration curves for 2 to 450 lb./min. air are available. Curves for other gases and gaseous mixtures can be determined. Indicator cost is \$395; price of the probe is \$190. —Hastings-Radist, Inc., Hampton, Va. 190A



### Sanitary Pump

**Positive-displacement unit has new impeller.**

Impressive reductions in replacement and maintenance cost are two advantages claimed by the manufacturer for the new "white rubber impeller" pump. Designed to handle products of high viscosity, the new sanitary pump develops pressures up to 150 psi.

All white-rubber impellers are non-toxic and will not absorb or impart flavors. For easy cleaning, impeller surfaces, as well as those of the pump cover, are smooth and flat. The manufacturer states that Type DO and BB pumps, now in operation, can be reconditioned to accept the new impellers. — Waukesha Foundry Co., Waukesha, Wis. 191A

### Maintenance Coating

**No sandblasting required to prepare surfaces.**

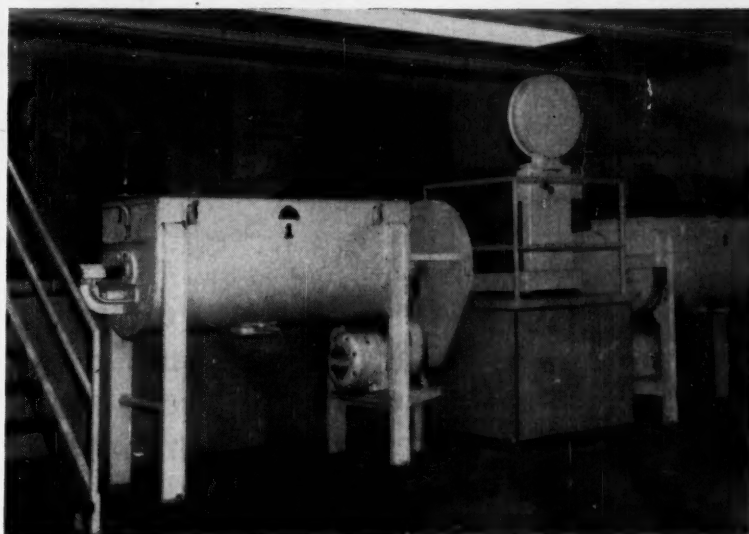
Extensive testing of exposure panels in industrial areas has shown that a new phenolic/vinyl system of maintenance coatings for metals eliminates the need for costly sandblasting as a means of surface preparation. The new system calls for use of a phenolic resin-based primer followed by a vinyl top coat. Prior to application of the primer to rusty metal, the only required surface preparation is wire brushing.

On wire-brushed rusty panels, the phenolic/vinyl combination gave a performance equalled only by all-vinyl sys-

# DAY mixes

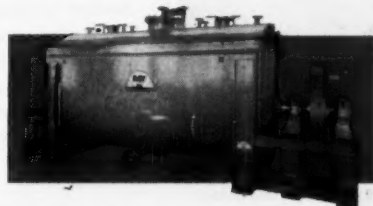
## in the best companies

Fearn Foods Inc. is one of thousands of old friends. They've used DAY Ribbon Blenders for years in their Franklin Park, Illinois, plant.



When the decision on what make of blenders to buy for their new modern Los Angeles plant came up, they just ordered three more DAY blenders. The reason — simply that DAY blenders have always given dependable trouble-free service. They operate smoothly, rapidly and efficiently. Their many features include outboard bearings that provide sturdy support for a solid alloy steel shaft. Stuffing boxes of sanitary seals for protecting bearings, prevent product contamination. They have a geared head motor, roller chain drive, galvanized or stainless tank, choice of agitators. Heating or cooling jackets optional. There is a complete line of DAY ribbon blenders available in capacities of 10 to 465 gal.

On the right is a DAY mixer from the Jumbo line. These rugged brutes are built for extra heavy loads. Capacities 600 to 3850 gal. Complete lab facilities available for testing your product.



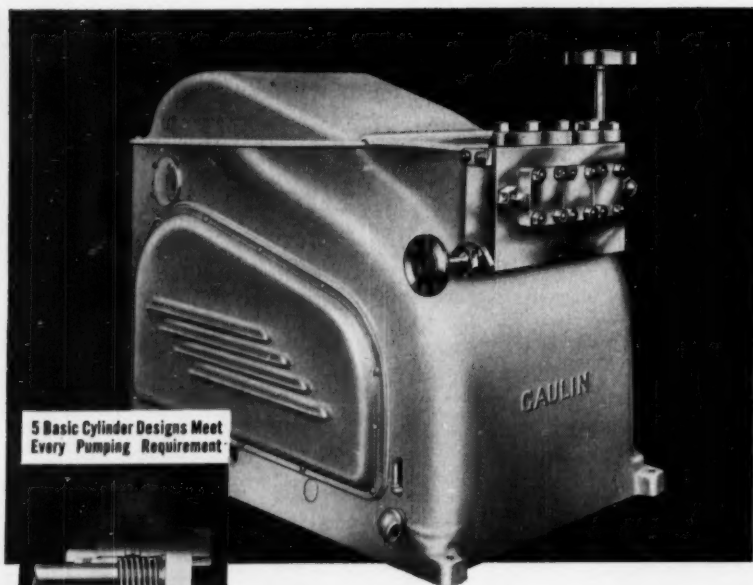
Join the many companies now enjoying the production benefits of DAY blenders and mixers. Write today for Bulletin 800.

**The J. H. DAY Co.**

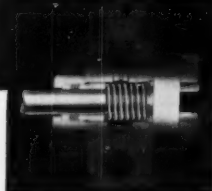
*Division of The Cleveland Automatic Machine Co.*

SERVING THE PROCESS INDUSTRY SINCE 1887

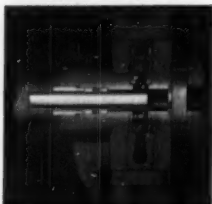
4926 BEECH STREET, CINCINNATI, 12, OHIO



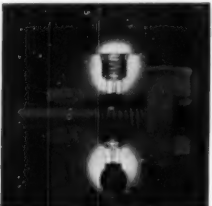
5 Basic Cylinder Designs Meet Every Pumping Requirement



Spring loaded packing



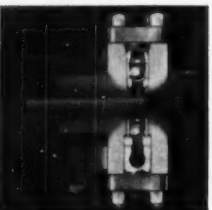
Packing adjusting screw style stuffing box



Poppet Valve, stainless steel



Ball valve, hardened inserted valve seat



Ball valve, removable seats

## Gaulin Triplex Pumps Increase Your Pumping Capacity, Extend Your Pumping Pressures . . .

### Reduce Operating and Maintenance Costs, Too!

Gaulin Horizontal Triplex Pumps handle large volume of all types and densities of fluids. Rugged, compact and dependable, they provide long service life at minimum maintenance costs in transfer, metering and spray drying applications.

**Horizontal Design** provides well area separating product from crank case.

**Well Area** can be gasketed for maintaining sterility . . . or for inert compatible chemicals (gases or liquid) for hazardous materials.

**Gaulin Cylinder** can be disassembled in minutes. Capacities from 50 to 6500 GPH . . . pressures from 500 to 12,000 psi.

Write for Bulletin P-55. At the same time ask for GTA . . . *Gaulin Technical Assistance* . . . for experienced advice and factual data on the best method to move or blend your product.



World's largest manufacturer of stainless steel reciprocating rotary, pressure exchange pumps, dispersers, homogenizers and colloid mills.

## NEW EQUIPMENT . . .

tems. Gloss retention and durability of the vinyl top coat augmented high corrosion resistance and adhesion of the phenolic primer. — **Union Carbide Plastics Co., New York, N. Y.** 191B

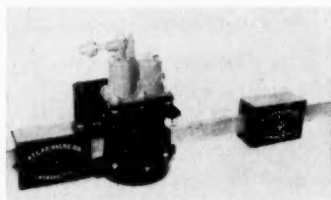


## Bearings

For ovens, hot conveyors, drying kilns, etc.

A new line of self-lubricating bearings is available for high-temperature applications. Material of construction for the new units is graphite impregnated with copper or silver, depending on the application.

Maximum recommended temperature for continuous bearing service is 750 F. For intermittent periods, temperatures of 1,000 F. are permissible; 1,500 F. can be tolerated in non-oxidizing atmospheres. — **Metalized Carbon Corp., Ossining, N. Y.** 192A



## Regulator Pilot

For maintenance of constant reduced pressures.

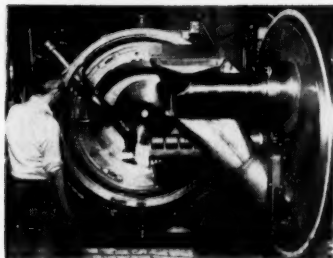
Known as the Fig. 8000 pilot, a new super-sensitive device reduces and regulates the pressure of liquids and gases within fractions of 1 psi. in one stage. The unit, which uses 20- to 75-



psi. air or water to actuate the control valve, is applicable to single- and double-seat valves ranging in size from  $\frac{1}{2}$  to 12 in.

Knife-edge bearings for mounting the beam virtually eliminate friction, according to the manufacturer. Changes of only a few ounces per square inch in the controlled pressures serve as an effective guide to govern diaphragm or piston valves.

Each unit can be modified easily to provide for reverse action.—Atlas Valve Co., Newark, N. J. 192B



### Crystal Dehydrators

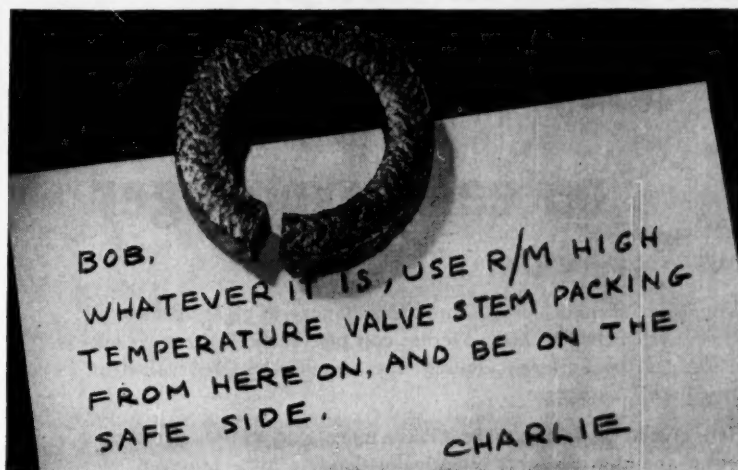
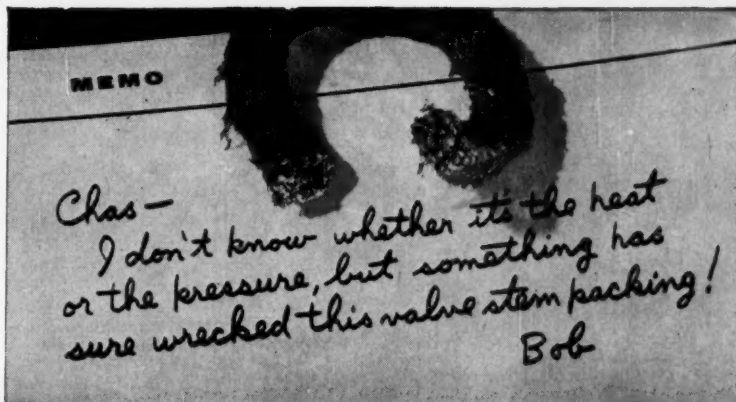
Meet demand for increased crystal drying capacity.

Designed to handle many types of crystals at rates of 20 to 24 tons/hr., the new C-41 Super-D-Hydrator is now available for either atmospheric or pressurized operation.

While basket diameter has gone up 50% over the largest previous model, potential power applied to the load has risen to 150 hp., an increase of over 100%. Rotational speed of the new machine is 1,250 rpm. These facts show contrast to traditional practices of reducing speed and applied centrifugal force as basket size increases.

This engineering accomplishment occurs by way of complete redesign—from the new "easy-lock" door and massive frame to the cake leveler, knife and slurry spreader.

In operation, C-41 runs on a continuous cyclic principle in which slurry feeds into the bowl; a thin cake of crystals forms on the screen; then the cake is washed, spun dry and discharged. This sequence re-



R/M's experienced packing engineers designed this line of packings to help you lick the problems caused by higher temperatures and greater pressures in today's processing lines. R/M High Temperature Valve Stem Packings contain practically no organic materials—and it is these organic materials which cause a lot of your trouble by burning and causing volume loss. Lubricants are ground in during manufacture; so they are thoroughly dispersed all through the packing. And braided asbestos yarn provides you with the maximum performance in pressure resistance.

Among the other packing products

engineered by Raybestos-Manhattan to meet difficult requirements are "Teflon"™ and "versi-pak"™. "Teflon" packings, because they show no reaction to any known industrial acids or caustics and are noncontaminating, can be of great help to you in a variety of applications. "versi-pak" is a highly engineered nonjacketed packing offering excellent performance with solvents, weak acids, and caustics over a wide range of conditions. Due to the many applications of both these packings, we suggest that you call on R/M's experienced packing engineers for specific recommendations. Their service is at your disposal.

R/M MAKES A COMPLETE LINE OF MECHANICAL PACKINGS—including Vee-Flex,® Vee-Square,® Universal Plastic, and "versi-pak"™; GASKET MATERIALS; "TEFLON"™ PRODUCTS. SEE YOUR R/M DISTRIBUTOR. \*A Du Pont trademark



## PACKINGS

RAYBESTOS-MANHATTAN, INC.  
PACKING DIVISION, PASSAIC, N.J.  
MECHANICAL PACKINGS AND GASKET MATERIALS

RAYBESTOS-MANHATTAN, INC., Mechanical Packings • Asbestos Textiles • Industrial Rubber • Engineered Plastics  
Sintered Metal Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings  
Brake Blocks • Clutch Facings • Industrial Adhesives • Laundry Pads and Covers • Bowling Balls

**Do-it-yourself  
cleaning  
saves chemical plant  
\$800 yearly  
on each exchanger**

A midwest chemical plant, running a battery of eight 20-foot oil cooler exchangers, found its average cost per yearly cleaning of each exchanger was \$1100. Searching ways to cut costs, they called in their local Oakite man.

Here's what happened. The Oakite man studied the exchanger set-up and the type and quantity of deposits to be removed. He recommended the particular Oakite cleaning compound exactly suited to the purpose. Then—Oakite service being what it is—he donned coveralls and boots and stayed on the job supervising and testing while circulation cleaning took place on the worst exchanger of the lot.

This exchanger had been so fouled up that when it was removed from the line it made only one degree difference in temperature change. After a 24-hour cycle of circulation cleaning, it was put back in the line. Temperature change—13 degrees! The plant men who inspected it judged it to be 95% clean.

Best of all, cost of cleaning an exchanger, including time and materials, went down from \$1100 to less than \$300.

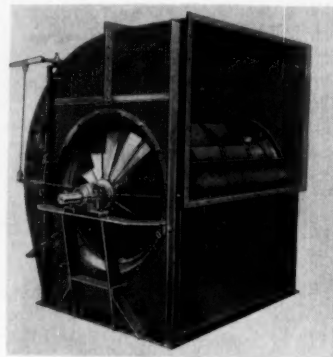
Exchanger cleaning is just one of the many chemical plant maintenance operations where Oakite can help to cut costs. For the full story, talk to your local Oakite man or write for detailed literature to Oakite Products, Inc., 16H Rector Street, New York 6, N. Y.



Technical Service Representatives in Principal Cities of U. S. and Canada

**NEW EQUIPMENT . . .**

peats automatically. Cake leveller and knife are hydraulically operated from the central control panel.—**The Sharples Corp., Philadelphia, Pa.** 193A



**Industrial Fan**

**Features aerodynamically shaped blades.**

Incorporating an advanced airfoil, backward curved-blade design, Type AF Dynafoil fans claim high efficiency and stable performance characteristics. Shape of each of the 12 blades, in combination with the streamlined contour of the inlet, holds turbulence to a minimum, thus assuring smooth continuous air flow.

Dynafoil fans come in 13 sizes for mechanical draft, and in Classes II, III and IV for heavy-duty industrial applications.—**Clarage Fan Co., Kalamazoo, Mich.** 194A

**BRIEFS**

**Positioning switch** provides faster and more reliable control of pneumatically operated valves and motors. About 20% smaller than earlier models, the new unit eliminates lags between control panel and actuator mechanism.—**The Powers Regulator Co., Skokie, Ill.** 194B

**Data processing system** known as the IBM 7090 has computing speeds up to five times faster than its predecessor, IBM 709. Fully transistorized, the new system can store more than 32,000 10-

# LADISH

*Controlled Quality*

## LIGHT WEIGHT WELDING NECK FORGED FLANGES 125 POUND



### POSITIVE, LEAK-TIGHT JOINTS

Proven design principle of raised face flange has been adapted to assure a completely safe, positive connection to class 125 cast iron flat face flanges.

### ELIMINATES NEED FOR HEAVY FLANGED ENDS ON VALVES AND PUMPS

No longer is it necessary to pay a premium to obtain the heavier flanged end valves, pumps and other piping components required to withstand bolting to raised face steel flanges in a welded piping system.

### LOW WEIGHT—AMPLE STRENGTH

Light cross section design reduces weight to 30-50 per cent of ASA 150 pound Welding Neck Flange... still possesses ample strength to assure safe, leak-tight joint with mating cast flange.

### LOWER COST

Savings in purchase price of Light Weight flanges are supplemented by additional savings realized by selecting valves on the basis of pressure rather than strength characteristic of flanged ends.

### EASE OF INSTALLATION

Adequate welding neck type hub length keeps welding heats safely from flange. Prevents unpredictable warpage and deformation. Light weight facilitates handling, speeds positioning and installation.

### MINIMIZES PIPEFITTER PRECAUTIONS

Safe and suitable for use with either carbon or alloy steel bolting... either full face or ring gaskets, in  $\frac{1}{16}$ " or  $\frac{1}{8}$ " thicknesses.

### PRESSURE-TEMPERATURE RATING

Rating corresponds to ASA B16.1 class 125 cast iron flanges... 125 PSI (gauge) saturated steam; 175 PSI (gauge) water, oil or gas at 150° F.

### SERVICE APPLICATIONS

Widely accepted for low pressure piping in gas distribution service... utility services such as water, heating, air conditioning, refrigeration... pumps and compressors.



TO MARK PROGRESS

**Reduce cost...  
eliminate breakage  
of cast flanged-end  
piping components  
when bolting to steel  
welding neck flanges**

### PIPING PROBLEM:

- (1) Difficulty experienced in making pressure tight connection with flat face flanges with full face gaskets.
- (2) Breakage of relatively brittle cast iron flanged ends on valves, pumps and other piping components when bolted to standard  $\frac{1}{16}$ " raised face steel flanges.

### LADISH SOLUTION:

The 125 pound Light Weight flange developed by Ladish is an ideal solution to this problem... for not only does it solve the problem... but it provides significant additional advantages of cutting purchase costs and reducing weight.

You can depend on Ladish for leadership in introducing piping developments to reduce cost and improve service.

A national network of distributors, Ladish plants and sales offices is ready to serve you.

Specification sheets on Light Weight Flanges and Welding Fittings available on request.



TO MARK PROGRESS

## LADISH CO.

CUDAHY (Milwaukee Suburb) WISCONSIN

SALES OFFICES: Amarillo • Atlanta • Baton Rouge • Buffalo • Calgary  
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SAW BLADES • PIPE FITTINGS • DROP FORGINGS • RINGS • VALVES

LADISH... THE FITTINGS LINE THAT OFFERS COMPLETE SERVICE IN TYPES, SIZES AND MATERIAL SPECIFICATIONS

WELDING  
FITTINGS

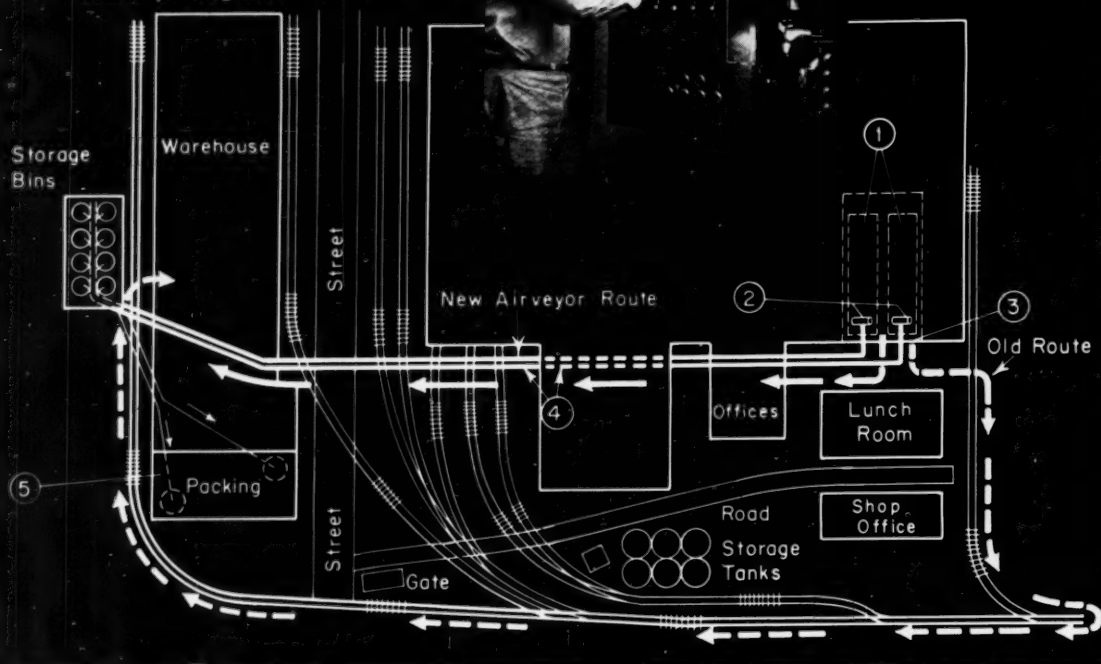
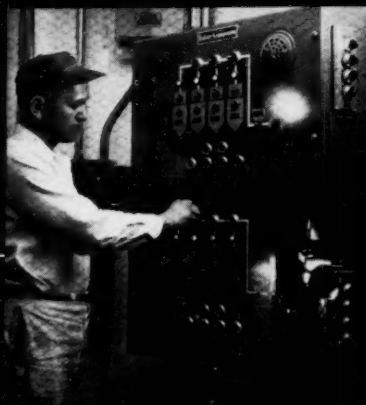
ASA & MSS  
FLANGES

SCREWED & SOCKET  
FITTINGS & UNIONS

LONG  
NECKS

LARGE DIAMETER  
& T.E.M.A. FLANGES

- 1 Two 10,000 lb. per hour starch driers.
- 2 Two Airveyors pump dried starch to storage bins.
- 3 Starch was bagged here and taken over old route to storage.
- 4 New Airveyor route is direct; passes through or over obstructions.
- 5 Airveyors reclaim stored starch, deliver to packing bins.



#### PLANT MODERNIZATION THROUGH PNEUMATIC CONVEYING

## FULLER pneumatic conveying system increases production without plant expansion

To increase production, the Union Starch and Refining Company's Granite City, Ill., plant first needed to expand their materials handling system. But a complete revamping of bagging and warehouse operations was impossible because there was no space available for necessary new buildings.

An Airveyor® System, engineered and built by Fuller, was the answer. Airveyor's extreme flexibility allowed it to be set up through walls, along sides of buildings, over streets, on roofs and up inclines. At Union Starch, the total

distance covered is 800 feet, with a number of 45 degree and 90 degree bends in the line.

The Fuller Airveyor system transports the starch in two phases, from the driers to the storage bins and from the bins to receiving hoppers over the bagging machines. Flow is controlled automatically through control panels located in the drier room and at the bagging machines. Other controls are also provided at the panels for automatic operation of components such as feeders,

blowers, conveyors and filter-receivers. Besides being easily installed and automatically controlled, the Fuller system reduces both the amount and the expense of handling. Additional savings are made possible by Airveyor's self-cleaning facility, which greatly reduces maintenance costs.

Why not work with Fuller to design an automated pneumatic materials handling system that will help you cut costs and increase production? Write today for complete details.

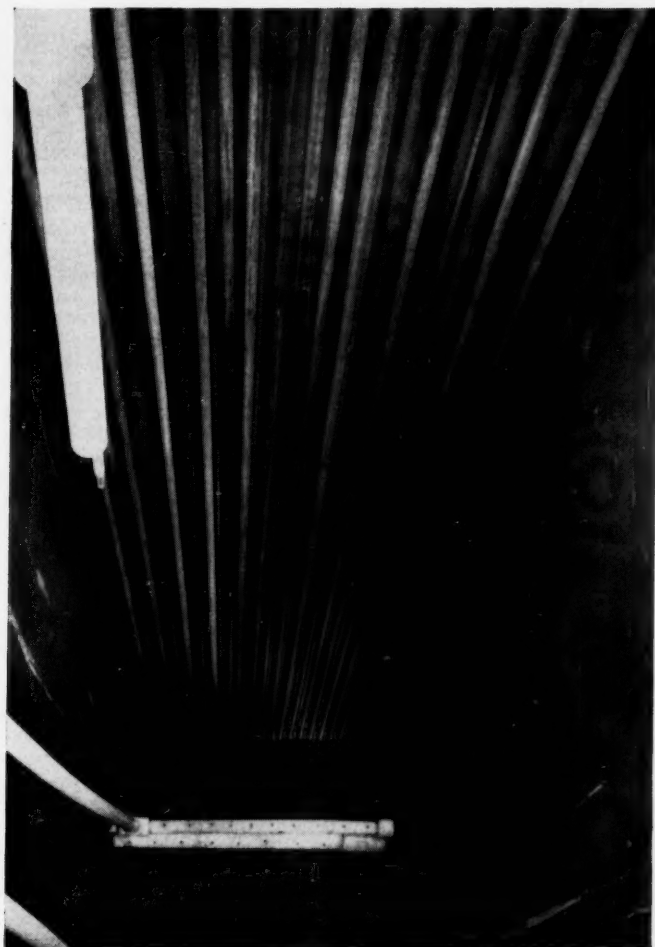
A-280  
1355



**FULLER COMPANY**  
134 Bridge St., Catasauqua, Pa.  
SUBSIDIARY OF GENERAL AMERICAN TRANSPORTATION CORPORATION  
Birmingham • Chicago • Kansas City • Los Angeles • New York • San Francisco • Seattle







## problem:

A chemical company, using a cold water heat exchanger to cool caustic soda and sodium hypochlorite, was being plagued by breakage in the 2" dia. glass tubing. Shutdowns occurred about three times monthly . . . each time consumed about 15 extra man-hours to change tubes . . . necessitated additional processing of contaminated hypochlorite.

## solution:

A heat exchanger was fabricated from Carpenter Titanium Tubing. Ten-foot lengths of this tubing were vertically submerged directly in each caustic soda processing vat.

## results:

Maintenance costs reduced nearly \$1500 annually! No tubing failure since Carpenter Titanium Tubing was installed two years ago! Increased production! Improved product quality! With a heat exchanger in each processing vat instead of separate unit, pumps and pump plumbing previously required to transfer highly corrosive fluid, and maintenance problems connected with them, have been eliminated!

## Carpenter Titanium Tubing tames corrosion ... reduces costs

Why not take advantage of the corrosion and cavitation resistance, light weight and high strength of Carpenter Titanium Tubing? It is the *least expensive* tubing you can use under many corrosion influences. It withstands conditions that reduce service life of ordinary metal . . . assures minimum downtime, fewer replacements.

Three commercial grades—C40, C55 and C70—in tubing sizes up to 4½" O.D. are available.

In the food, chemical, pulp, paper and allied industries . . . the long, trouble-free service life of Carpenter Titanium Tubing provides countless opportunities to improve equipment performance and to reduce operating and maintenance costs. Contact your local Carpenter representative or distributor for the full story.



Write for Bulletin T.D. 115A. Contains complete data on the properties, corrosion resistance and application benefits.

*your master key  
to cost-saving  
corrosion control*



**titanium tubing & pipe**



## Neptune "Meter with a Memory" never forgets the formula

Why waste a good man's time counting buckets, remembering formulas, waiting for liquids to creep up to gauge marks, repeatedly running the risk of counting or reading errors?

Let the precise "mechanical memory" of this Neptune repeating Auto-Stop meter do the work. Set the quantity required by the formula just once. Open the valve. The meter does the rest... shuts off automatically at the exact amount. Even prints a batch ticket if you want. The meter "remembers"...delivers the same amount each time the valve is opened until reset for a different quantity.

A meter helps a good operator produce more, with consistently better quality, less back-breaking work, and better housekeeping. Investigate this cost-saving meter today. Our field engineers will be glad to help.



### GET THE FACTS

Ask for helpful  
Meter Data  
Bulletin 566 Y  
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Engineering Catalog.

## NEPTUNE METER COMPANY

19 West 50th Street • New York 20, N.Y.

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### NEW EQUIPMENT . . .

digit numbers.—IBM Data Processing Div., White Plains, N. Y. 194C

Circulation heater for both liquid and gas comes fully equipped with insulated pipe assemblies, thermostats and multitube flanged immersion heating units. Controlled temperatures to 550 F.—Trent, Inc., Phila., Pa. 198A

Medium computer can do data processing and scientific computation simultaneously at high speeds. Called the Honeywell 800, the transistorized machine has a maximum input rate per magnetic tape of 96,000 decimal digits per sec.—Minneapolis-Honeywell Regulator Co., Philadelphia, Pa. 198B

Air motors for heavy-duty service combine extremely high starting torque and sustained load-lugging ability with a simple throttle valve that enables instant starts and stops, reversibility and speed variation. Maximum rating at 90 psi. is 20 hp.—Joy Mfg. Co., Pittsburgh, Pa. 198C

Diesel engines feature simplicity of design, ruggedness and ease of servicing. The new 21000 is turbocharged and develops 340 hp. at 2,000 rpm. Model 16000, which is naturally aspirated, gives 230 hp. at 2,000 rpm.—Allis-Chalmers Mfg. Co., Milwaukee, Wis. 198D

Mobile pump comes in capacities from 1 to 40 gpm. in a choice of 18 different materials of construction. Called the Port-A-Pump, the unit is designed for acid-handling applications requiring versatility and mobility.—Vanton Pump & Equipment Corp., Hillside, N. J. 198E

Inert gas generator having a 200,000-cfh. maximum capacity is undergoing final stages of design. In operation, inert gases are generated by combustion of propane and air in an enclosed cylinder.—Birlec Ltd., Birmingham, England. 198F

Flow switch protects pumps in event that flow ceases or becomes excessive. Series C Flow switches are suitable for use with most fluids—no packing or diaphragms.—**Ball Mfg. Co., Inc., Torrance, Calif.** 199A

Shut-off gates for dry, granular chemicals come in 12- through 30-in. sizes. The new double-rack and pinion units are claimed to be dust-tight and self-cleaning. — **Beaumont Birch Co., Phila., Pa.** 199B

Pipe strainers having multistep construction mount directly into any 2- to 24-in. line using conventional Schedule 40-S pipe and Series 15 flanges. Opening sizes range from 0.0013 to 0.0307 in.—**Air-Maze, Cleveland, Ohio.** 199C

#### Equipment Cost Indexes . . .

	Sept. 1958	Dec. 1958
<b>Industry</b>		
Avg. of all. . . . .	230.9	231.3
<b>Process Industries</b>		
Cement mfg. . . . .	223.3	223.7
Chemical . . . . .	232.3	232.7
Clay products . . . .	217.0	217.4
Glass mfg. . . . .	219.3	219.7
Paint mfg. . . . .	222.8	223.1
Paper mfg. . . . .	223.8	224.2
Petroleum ind. . . . .	227.5	227.8
Rubber ind. . . . .	230.3	230.6
Process ind. avg. . .	228.6	228.8
<b>Related Industries</b>		
Elec. power equip. . .	236.0	236.4
Mining, milling . . . .	233.7	234.1
Refrigerating . . . . .	260.3	260.6
Steam power . . . . .	218.1	218.4

Compiled quarterly by Marshall and Stevens, Inc. of Ill., Chicago for 47 different industries. See Chem. Eng., Nov. 1947, pp. 125-6 for method of obtaining index numbers; Feb. 23, 1959, pp. 149-50 for annual averages since 1913.

#### For More Information . . .

about any item in this department, circle its code number on the

#### Reader Service

postcard (p. 213)

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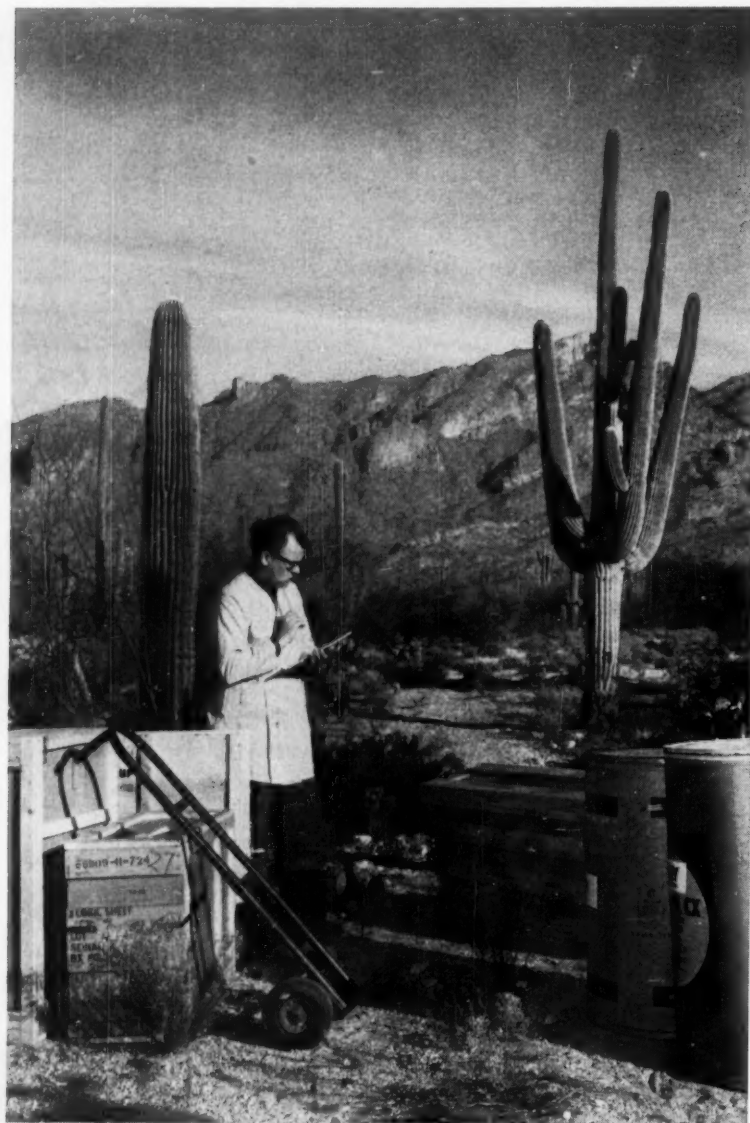
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## TECHNICAL

### Written for the Chem. E.

URANIUM ORE PROCESSING. Edited by John W. Clegg and Dennis D. Foley. Addison-Wesley Publishing Co., Reading, Mass. 436 pages. \$7.50.

If you're at all concerned with or interested in the problems related to ore processing, you'll treasure this fine volume.

It is certainly written with the chemical engineer in mind. Starting with the first five chapters on uranium mineralogy, exploration, mining, sampling and analysis, the authors emphasize points which affect the chemical processing steps that follow.

Then, quite logically, the authors treat the processing steps as they normally take place, and one at a time: roasting, physical concentration, acid or carbonate leaching, liquid-liquid separation, uranium recovery by ion exchange or solvent extraction. **►No Waste of Time**—And there's no waste of your time or the book's space for detailed explanation of unit operations we're already quite familiar with, such as physical concentration, leaching, thickening, filtration, solvent extraction and so on. Only applications or operations unique to uranium-ore processing are discussed to any extent.

To add to the book's value, an entire chapter is devoted to six examples of uranium milling operations that actually make use of the techniques treated in the foregoing chapters. The great detail presented here will be invaluable to those concerned with the problems of ore processing.

One of the final chapters treats the "marginal" sources of uranium, which are exploited only on a limited scale, such as Florida's uraniferous marine-phosphate deposits. Another chapter discusses the health and safety problems unique to uranium-ore processing.

Those thirty-two contributing authors and two editors who compiled this volume are indeed



## BOOKSHELF

J. B. BACON

well qualified. Clear editorial presentation and excellent illustration heap more merit on the book. Not only is it an invaluable reference, but it makes for pleasant reading.—JAK

### BRIEFLY NOTED

**BOOK OF ASTM STANDARDS**, 1958 edition. 13,600 pp. *American Society for Testing Materials*, 1916 Race Street, Philadelphia 3, Pa. Full set of 10 parts, \$116; parts available individually. Full set contains 2,450 standard specifications, methods of test, definitions of terms and recommended practices.

**EFFECTIVE UTILIZATION OF SCIENTISTS AND ENGINEERS**, Proceedings of the Delaware Valley Conference. 137 pp. plus 29-p. survey of literature. Order through Conference Secretary, Dr. Allen T. Bonnell, Drexel Institute of Technology, 32nd and Chestnut Streets, Philadelphia 4, Pa. \$2. Proceedings of conference sponsored by industries, educational institutions and professional societies of the Delaware Valley under the auspices of the President's Committee on Scientists and Engineers.

**ORGANOLITHIUM COMPOUNDS IN ORGANIC SYNTHESIS**, Annotated Bibliography, Supplement No. 5. 451 abstracts. Request on Company letterhead to: Gerald A. Munson, Director, Technical Service Div., Lithium Corp. of America, Inc., 1100 Title Insurance Bldg., Minneapolis 1, Minn. \$1.50. Supplement contains abstracts of papers published during 1956 and 1957, brings to 1,472 the total of abstracts reviewed since 1949.

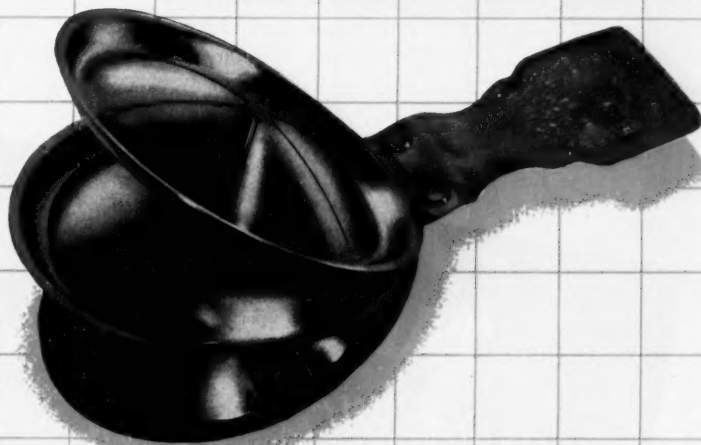
### MORE NEW BOOKS

**INTRODUCTION TO CHEMICAL ENGINEERING THERMODYNAMICS**, 2nd ed. By J. M. Smith and H. C. Van Ness. McGraw-Hill. \$8.75.

**RADIOACTIVITY MEASURING INSTRUMENTS**. By M. C. Nokes. Philosophical Library. \$4.75.

**A GUIDE TO NUCLEAR ENERGY**. By R. F. K. Belchem. Philosophical Library. \$3.75.

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The big advantages of Taper-Lock mounting are now available for practically all of your sprocket installations. Below is listed the new wide range of types and sizes offered by Dodge!

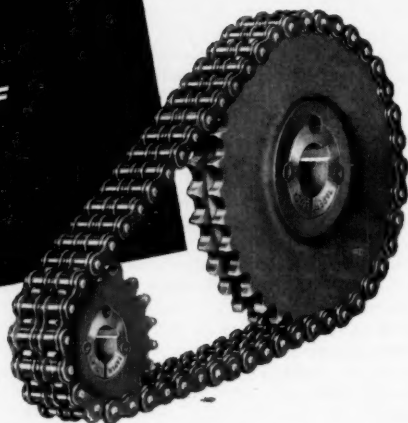
This important expansion of the Dodge line is the result of the enormous popularity of the Taper-Lock idea. Taper-Lock Sprockets are *modern*. Industry likes them because they go straight from shelf to shaft without

machining—saving time. They are “easy on—easy off”—saving work. Their bushings can be re-used, not only in replacement sprockets, but in sprockets of different sizes and also in Taper-Lock Sheaves, Couplings, Conveyor Pulleys. Taper-Lock saves inventory—and money!

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Transmission Series (No. 2040 to 2080) and Conveyor Series (No. 2040 to 2100). Sprockets to 112 teeth—including, for the first time, stock sprockets of 17, 19, 21, 23, 25 and 35 teeth *made especially for double pitch chain*. Introduced by Dodge, these sprockets are designed for even distribution of tooth engagement and absolute accuracy of mesh. Wear is reduced by half. Life of chain and sprocket is doubled!

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Steel Plate, Type A. No. 35 to 120. Mandrel bore, bored-to-size or Taper-Lock.

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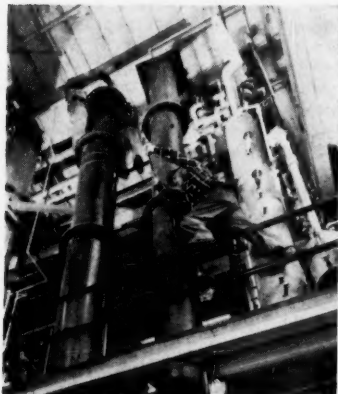
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PEOPLE...

## LETTERS: PRO & CON

C. H. CHILTON



### Con: Unsafe Practices

Sir:

I am appalled to think that a company could knowingly give world-wide recognition to the unsafe practices of its employees, and how a safety-minded magazine like *Chemical Engineering* could publish such a picture. I am referring to the picture in *Firms in the News* (Nov. 3, p. 158).

This picture shows one man standing on a handrail and another perched on a flange; neither man is equipped with a safety belt. This is an excellent example of what not to do.

I certainly hope you will refrain from printing this type of picture in the future.

GEORGE J. ZACHMANN, JR.  
E. I. du Pont de Nemours & Co.  
Wilmington, Del.

► To compound the felony, we are reprinting the damned picture herewith. But this time we shall graciously refrain from identifying the company giving such world-wide recognition to its unsafe practices.  
—Ed.

### Con: Short-Order Ph.D.'s

Sir:

Your article on those short-order Ph.D.'s, British style (Jan. 12, pp. 142-6), entirely ignores certain basic facts of engineering education:

1. Engineering in England is a comparative latecomer to the universities. Most British engi-

neers take Membership examinations in the various Institutions which allegedly are "equivalent" to B.S. degrees. Practically, however, a B.S. from a university counts for much more, and the Memberships are regarded as equivalent only by those possessing them. The system of advanced training described in your article is merely a continuation of this practice, for which there is no parallel in the U. S. (except, in part, the P.E.).

2. British M.S. and doctorates are pure research degrees, without stipulating any fixed program of credits. Again, their problems are different from ours.

3. A doctorate should imply an addition to the existing knowledge. If chemical and other engineering curricula tend to over-emphasize technical refinements rather than the relation between technology and economics, that's the fault of the individual school and not of the system. There is plenty of advanced work to do in all these fields.

4. It seems to me that certain individuals are itching to be *Herren Doktoren* without doing original research. Perhaps the solution lies in offering them another degree 60 points beyond the B.S., minus the dissertation. Columbia does this now, and the Russian *Kandidat* degree is similar.

Having acquired three Memberships, an English B.S., an American M.S. and (almost) Ph.D., plus a P.E., I think I can evaluate the merits of these various routes to academic glory.

JOHN E. ULLMANN  
Stevens Institute of Technology  
Hoboken, N. J.

► Our thanks to (almost) Dr. Ullmann for shedding added light on the new British route to academic glory.

While we accept his facts, we question his opinion that "a doctorate should imply an addition to the existing knowledge." The country is full of physicians and dentists who never completed a major research project nor wrote a thesis, yet whose claims to the title of

## DODGE PRODUCTS

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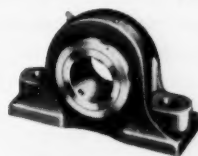
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## PRO & CON . . .

Doctor are never questioned. According to dictionary definitions, the title recognizes an advanced level of learning, with no implication as to the route pursued.

Our article raised this basic question: Why should a research project be the only acceptable route to the highest degree in chemical engineering, in view of the fact that the majority of graduate engineers pursue other fields than research? As we pointed out, some of the leading chemical engineering educators in the U.S. are now studying this problem.—Ed.

## Reduction, Not Oxidation

Sir:

The article beginning on p. 66 of your Jan. 12 issue is very interesting and calls to the attention of your readers an important area of air pollution control.

I was surprised, however, to read that you called the process "catalytic oxidation." When one converts nitrogen oxides to elemental nitrogen, the process is reduction.

A much more important source of nitrogen oxides in the atmosphere than tail gases from nitric acid plants is automobile exhaust. The Air Pollution Foundation has recently activated a project at the Franklin Institute to study the possibility of reacting nitric oxides in auto exhaust with carbon monoxide in the exhaust to produce carbon dioxide and nitrogen. We have been thinking all along that we were trying to reduce the nitric oxide.

W. L. FAITH

Air Pollution Foundation  
San Marino, Calif.

► Our headline writer goofed in using the word "oxidation" incorrectly. However, this error does not occur in the article proper.—Ed.

## Help for the Poor M.D.

Sir:

It has been several weeks since I read the salary survey of the Cornell graduates in your magazine (Dec. 29, p. 67).

My grief is deep for the poor M.D.'s who are averaging only slightly over \$200/mo. I am enclosing my personal check in the amount of \$10 as a contribution to all the practicing M.D.'s who graduated from Cornell in



1953 and have a salary of only \$2,600/yr.

Don't you think we high-salaried engineers should start a drive to try to get the M.D.'s salaries increased?

JOHN J. MCKETTA  
University of Texas  
Austin, Tex.

Sir:

This is one of what probably will be a flood of letters you will receive concerning the reported earnings of medical doctors who graduated from Cornell in 1953, as reported in your Dec. 29 issue (pp. 67-68).

An average income for this group of \$2,825 must be the result of a deliberate attempt to mislead the Cornell University Placement Service and the public. Were these doctors amortizing the expense of their education in one year and then reporting what was left over?

An associate of mine had several friends about to finish their internship in St. Louis who had recently shopped around as to where they would set up practice. They learned they could be assured of earning \$10,000 or more their first year. I have a doctor friend in a small town in the South who, four years out of school, was earning more than \$50,000/yr.

Frankly, I am amazed at your accepting these figures and agreeing that "after five years they are still struggling to earn enough to live on."

JAMES J. KOENIG  
East St. Louis, Ill.

Sir:

I read with interest your article, "A Medley of Salary Data for 1958," in your Dec. 29 issue. I question, however, the median salary (\$2,350/yr.) for graduates in medicine. Is this perhaps in error?

E. LANG  
National Lead Co.  
Fredericktown, Mo.

► The data are correct; the error was in our method of presentation. The earnings we reported are for people who received their first degrees in 1953. Those who entered the field of medicine, therefore, were barely out of internship in 1958.—Ed.

## PLASTIC PIPE AD WITH NO PICTURE?

Why  
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Because almost all plastic pipe looks the same. You know yourself that looks can be mighty deceiving, and piping that goes wrong can be mighty expensive. A picture means nothing... but...

There are scores of brands of plastic pipe on the market... made of a dozen different kinds of materials. Most of it is labeled "corrosion-resistant" but the results may be good, bad or indifferent depending on your choice. A picture is no help. Here's what to look for instead:

**The universal material?** No such thing. No one plastic can handle all liquids and gases... no one has all the physical properties required of a truly universal pipe. Closest to it are Ace Riviclор (Rigid PVC) and Ace-Ite (rubber-plastic blend). The former is a little better on chemical resistance, the latter is a little better on impact strength and heat resistance. Both same price.

**Are plastics strong enough?** Thousands of chemical plants say "yes". Pipe is now available in several wall thicknesses... in flexible tube sizes (Ace-Flex clear transparent), up through gas-tubing sizes (Ace-Ite and Ace Riviclор), through flexible Supplex polyethylene pipe, and Schedules 40 and 80 rigid plastic pipe for pressures up to 490 psi.

Above that, there's Ace rubber-lined steel pipe. And don't forget Ace soft-rubber-lined pipe for resistance to abrasion.

20 valuable pages... comparable properties, chemical resistance, costs, etc. of 11 plastics and rubber materials  
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**Is there a plastic for hot corrosives?** Yes, Ace Tempron, which is good to 275 deg. F. with most chemicals. Stays chemical resistant, strong, and rigid where other plastics may be attacked or may sag.

**How can I dodge "trial and error"?** Go to a company that has no axe to grind. We, for instance, make no less than nine different kinds of pipe... with fittings and valves to match... and give you thoroughly unbiased advice backed by 100 years of experience and prices as low as you'll find anywhere.

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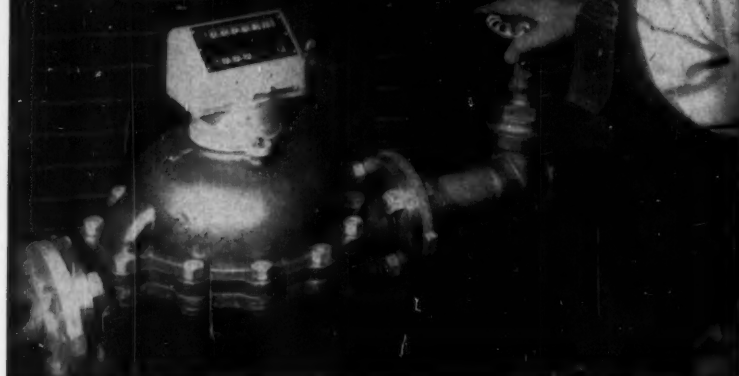


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#### READER SERVICE . . .

### TECHNICAL

#### Contents of This Issue

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Pumps, blowers, compres- sors . . . . .	224
Services & processes . .	226

#### Chemicals

**Acetal Resins** . . . . . 32 p. manual on the properties and uses of company's polyvinyl butyral and polyvinyl formal contains formulations, other application suggestions.

206A Shawinigan Resins Corp.

**Acrylic Fiber** . . . . . 51 p. brochure deals with procedures for applying various classes dyes to new acrylic fiber, Creslan. Shows fastness properties of dyes.

206B Allied Chemical

**Aldehydes** . . . . . 38 p. booklet covers physiological properties, specifications and test methods, bibliography, storage and handling, specific specialty applications.

206C Union Carbide Chemicals

**Amines, Tertiary** . . . . . 10 p. Bulletin No. B6-R3 provides formulations with tertiary amines used as catalysts in the manufacture of polyurethane foams.

206D Armour Chemical Div.

**Ammonium Bicarbonate** . . . . . Tech. Report 401A outlines how ammonium bicarbonate improves hydrogen peroxide bleaching. Gives details on bleaching solution, application.

206E Henry Bower Chemical Mfg. Co.

**Antioxidants** . . . . . 12 p. "Catalin Antioxidants" gives fully documented laboratory data on physical & chemical properties, effectiveness in various applications.

206F Catalin Corp. of America

**Borohydrides** . . . . . Pelletized Borohydrides for continuous fixed-bed, in-stream carbonyl group & peroxide reductions. Pellets are 10/32" & 24/32" in diameter.

93 \*Metal Hydrides Inc.

**Catalyst** . . . . . 20 p. Data Bulletin No. 3 describes Dabco, a new one-shot polyether catalyst for producing urethane foams. Describes various formulations, properties.

206G Houdry Process Corp.

\* From advertisement, this issue.

## LITERATURE

E. M. FLYNN

**Chemicals.**.....New booklet "Mutual Chromium Chemicals" contains information on sodium bichromate, sodium chromate, chromic acid, potassium bichromate, etc.

97 \*Allied Chem. Corp., Solvay Process

**Chemicals, Organic.**.....1959 edition of "Physical Properties," 28 p., covers over 400 synthetic organic chemicals. Tabulates carefully determined physical properties.

207A Union Carbide Chemicals

**Diethyl Succinate.**.....4 p. bulletin gives physical, physiological and chemical properties of the succinate, useful intermediate for mordants, plasticizers.

207B Union Carbide Chemicals Co.

**Fluorochemicals.**.....FC 75 has outstanding value in electronics, where it serves as a coolant & insulating fluid. It is nontoxic, non-flammable, etc. Information available.

178-179 \*Minnesota Mining & Mfg. Co.

**Glycols.**.....The industrial glycols have received comprehensive treatment in a new 80 p. booklet. Describes used as antifreezes, coupling agents, humectants.

207C Union Carbide Chemicals

**Hydrofluoric Acid.**.....Poster 17" wide by 22" long is now available. It covers necessary precautions for handling hydrofluoric acid such as use of water as neutralizer, etc.

73b \*General Chem. Div., Allied Chem.

**Hydroquinone Derivatives.**.....Catalog discusses physical and chemical properties, specifications, toxicity and applications of hydroquinone dimethyl & monomethyl ether.

207D Ansul Chemical Co.

**Magnesium Oxide.**.....A test sample of low-iron, low-lime MgO in any of its three forms; powdered, pelletized or granular, is yours for the request.

111 \*International Minerals & Chemical

**Nitric Acid.**.....Precautions in using Nitric Acid are contained in a large, easy to read poster which is now available. Suggests proper clothing to wear & equip. to use.

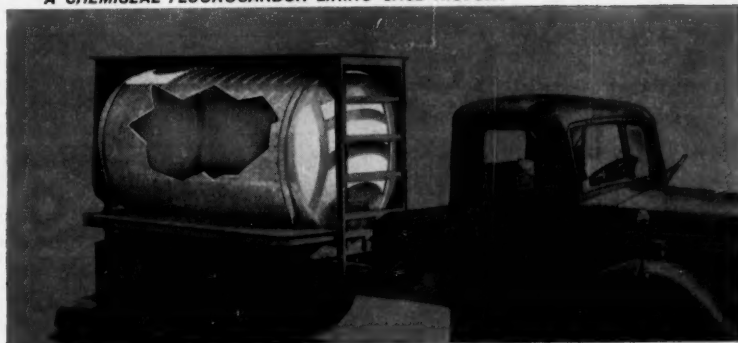
73c \*General Chem. Div., Allied Chem.

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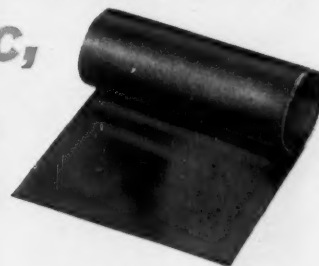
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## Hydrochloric, Hydrofluoric, Nitric Acids



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Worcester, Massachusetts to assure

safe, economical haulage of waste

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ELECTRO-CHEMICAL ENGRG. & MFG. CO., EMMAUS, PA.

METALWELD, INC., PHILADELPHIA, PA.

Or write for Bulletin AD-152. Special Products Dept., United States Gasket Company, Camden 1, New Jersey.

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### LITERATURE . . .

**Silicones** . . . . . 16 p. 1959 reference guide to company's silicone products, their function in adhesives, release agents, resins, rubbers, dielectrics, water repellents.  
208A Dow Corning Corp.

**Sodium Sulfite** . . . . . Revised technical bulletin on the use of sodium sulfite, anhydrous technical, for removing oxygen from boiler feed water.  
208B Monsanto Chemical Co.

**Sulfuric Acid** . . . . . A large & easy to read poster spells out precautions that must be taken when handling this chemical. Includes information on first aid.

73a \*General Chem. Div., Allied Chem.

**Trichlorethylene** . . . . . A 40-pg. booklet includes physical & chemical properties, reference to handling & storage procedure, section on toxicity & safety measures.  
59a \*Hooker Chemical Corporation

**Urethane Resin** . . . . . Three new bulletins packaged in one folder cover Righthane 112 foaming resin. Cover types and name of mold release agents, catalysts.  
208C Thiokol Chemical Corp.

### Construction Materials

**Alloys** . . . . . Full information on corrosion-resistant alloys, their properties, forms, the corrosives they will resist, contained in a 104-page book.  
173 \*Haynes Stellite Co.

**Bus Conductor** . . . . . Aluminum bus is easy to handle & fabricate and is available in a wide variety of sizes. The Aluminum Bus Conductor Handbook is offered.

101 \*Aluminum Company of America

**Coatings Protective** . . . . . for steel tank lining, concrete tank lining, concrete floors, tank cars, etc. Booklet outlines the complete selection of Plasite.

R237 \*Wisconsin Protective Coating Co.

**Fabrication** . . . . . Brochure "Working With Metal" gives factual information on designing, engineering and specialized fabrication in chemical processing.  
199 \*The Boardman Co.

**Filter Fabrics** . . . . . Complete information to help you with your filter cloth problems is contained in booklet "Filter Fabric Facts". Available now.  
42 \*Wellington Sears Co.

**Fused Quartz** . . . . . Vitreosil is available in an unusually wide variety of types & sizes. Offers outstanding electrical properties & extreme heat resistance. Tech. Data.

L210 \*Thermal Amer. Fused Quartz Co.

**Insulation, Blanket** . . . . . is ready for installation and easily conforms to surfaces. Gives maximum thermal efficiency at temperatures as high as 1200F.  
62 \*The Eagle-Picher Co.

**Insulation Pipe** . . . . . Eight-page brochure describes Kaylo pipe and equipment insulations, which are effective for temperatures up to 1,800 F. Illustrations.  
208D Owens-Corning

\* From advertisement, this issue.

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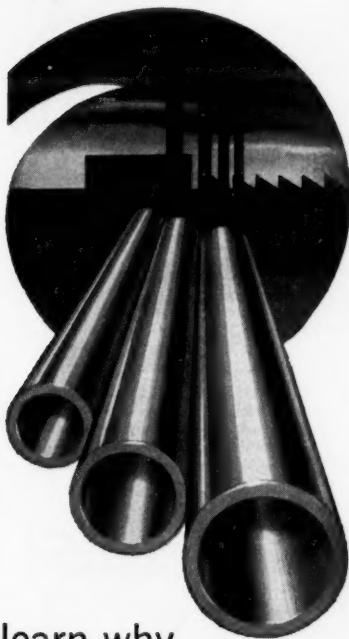
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## LITERATURE . . .

**Linings, Plastic . . . . .** Fluorocarbon linings are impervious to all the most difficult acids, alkalis & other highly corrosive chemicals. Details in Bulletin AD-152.  
207 \*U. S. Gasket Company

**Ni-Resist Ductile Irons . . . . .** Booklet contains full story of this cast metal. Tables and graphs explain mechanical and physical properties. Proven applications.  
209A International Nickel Co.

**Platinum-Group Metals . . . . .** Platinum-clad metals are available in sheet, wire, tubing, foil and gauze. Information contained in catalog sheet PLA-5.  
4 \*Metals & Controls Corp.

**Rubber Butyl . . . . .** is the ideal material for wire & Power cable, transformers, tapes, busbars & other insulation applications. Resists weather, chemicals, etc. Data.  
25 \*Enjay Company, Inc.

**Vacuum Retorts . . . . .** used for high-temperature vacuum annealing. Facilities & skills cover a wide range of tanks, furnace retorts, tanks & other fabrications.  
BL237 \*Rolock Inc.

**Wire Cloth and Mesh . . . . .** New booklet provides information on the physical advantages of wire cloth and indicates the range of weaves and sizes available.  
209B International Nickel Co.

## Electrical & Mechanical

**Casters & Wheels . . . . .** Feature rubber treads, rust-proofed, string guards, and lubrication. A manual outlining all features in detail is now available.  
R210 \*Darnell Corp. Ltd.

**Drives, Roller Chain . . . . .** are now available in a new wide range of types & sizes. Bulletin on taper-lock sprockets & roller chains is now available.  
202 \*Dodge Mfg. Co.

**Drives Variable - Speed . . . . .** Bulletin G-5812 covers complete line of drives that provide infinitely adjustable output speeds from constant-rpm. motor.  
209C Reeves Pulley Co.

**Drives V-Belt . . . . .** New 44-page bulletin describes a completely new line of v-belt drives that are smaller, cost less, and weigh less than conventional drives.  
209D Dodge Mfg. Corp.

**Gearmotors . . . . .** Bulletin 3050 offers engineering information on gearmotor ratings of 1/3 to 30 hp, single reduction, with output speeds of 23 to 280 rpm.  
209E Louis Allis Co.

**Gearmotors . . . . .** available in vertical & horizontal, right angle & parallel shaft, worm, helical & herringbone gearing. In 1/8 thru 125 hp. Details sent upon request.  
239 \*Reliance Electric & Engineering

**Generators . . . . .** for high-quality automatic package boilers, 10 to 600 HP. Cuts fuel consumption by 36%. Catalog gives latest information, covers every problem.  
43 \*Ames Iron Works Inc.

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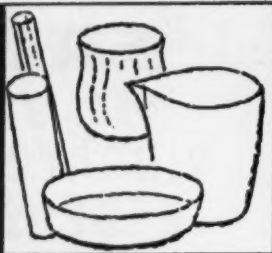
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## LITERATURE . . .

**Motors Single-Phase.** . . . Bulletin 470-B describes a new, expanded line of integral horsepower single-phase motors. Available in ratings from ¼ to 20 hp.  
210A Robbins & Myers, Inc.

**Plug-In Units.** . . . Bulletin SD-110 gives the facts on aluminum plug-in duct. They feature exclusive hook-swing mounting. The duct is completely enclosed.  
115 \*Square D Company

**Speed Variators.** . . . Power transmitted from input to output shaft through alloy steel driving balls which are in pressure contact with discs attached to the 2 shafts. Bul. K-200.  
75 \*Cleveland Worm & Gear Co.

**Switches Centrifugal.** . . . New product bulletin illustrates the features of a new centrifugal switch, adjustable speed range 70 to 5,000 rpm. Application data.  
210B Euclid Electric & Mfg.

**Thermocouples.** . . . Ceramco thermocouples for problems of high temperature, moisture, abrasion, corrosion or difficult installation. Details available in EDS-45-E.  
131 \*Thermo Electric Co., Inc.

**Turbines.** . . . Complete details on these Vertical Steam turbines contained in Catalog 200. Turbines in sizes 1 hp to 250 hp. Feature brake rim for added safety.  
161 \*Coppus Engineering Corp.

**Variable Speed Drive.** . . . Features unlimited speed range, true compactness, & automated speed control. Catalog outlining other features is now available.  
227 \*Graham Transmissions, Inc.

## Handling & Packaging

**Bucket Elevators.** . . . A complete line makes it easy to select the proper type bucket elevator & components best suited to your material & capacity requirement. Details.  
81 \*Link-Belt Co.

**Bulk Handling.** . . . "New Techniques for Automatic Bulk Handling" describes advance pneumatic conveying methods in integrated manufacture. Details two installations.  
210C Dracoo Div.

**Cans.** . . . "F" style cans have a recessed bottom that fits securely on top of can below. Available in 5 convenient sizes ranging from 8 oz. to 1 gallon size.  
83 \*Continental Can Co.

**Dry Feeder.** . . . New 16-page bulletin discusses the construction and operation of volumetric, extrusion-type dry chemical feeders. General technical data and graphs.  
210D Inflico Inc.

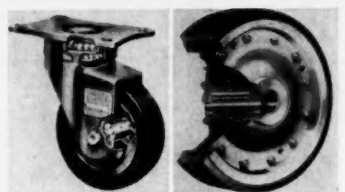
**Pneumatic Conveying.** . . . Bulletin M-588 tells how to improve plant efficiency 6 ways with modern airline conveying systems. Combines product drying & cooling.  
220 \*The Day Company

**Pneumatic Conveying System.** . . . The Airveyor system is easily installed & automatically controlled. Features self-cleaning facility. Complete details available.  
196 \*Fuller Company

\* From advertisement, this issue.

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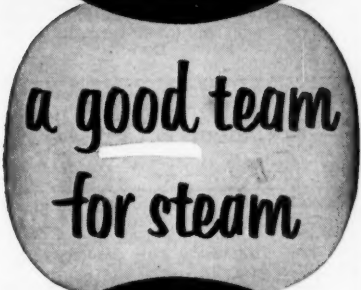
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#### LITERATURE . . .

**Pneumatic Handling.....**Discussion of improved materials handling brought about by equipment arrangements in combinations that supplement each unit. Booklet. 211A Fuller Co.

**Screw Conveyors.....**New literature describes custom fabricated screw conveyors made of stainless, Inconel, monel, Hastelloy, Illium and Nitralloy. Any diameter. 211B Central Mine & Equipment

**Straddle Carrier.....**Brochure gives full specifications and construction features of the 40,000-lb. capacity Series 95 straddle carrier. Operating characteristics. 211C Clark Equipment Co.

**Tractor Shovel.....**The 72 hp. 6 cylinder engine provides smooth power through matched torque converter & torque transmission. Handles 2500 lb. carry capacity. Details. 30 \*Yale & Towne Mfg. Co.

**Tractor - Shovels.....**"Payloador" is available for the HA model with 2,000-lb. carry capacity up to 4-wheel-drive 9,000-lb. carry capacity unit. Data. 37 \*The Frank G. Hough Co.

**Vibratory Feeder.....**Provides accurate, uniform rate of feed of bulk material...variable from ounces to tons. New glass fiber springs reduce breakage. Fact File. R209 \*Eriez Mfg. Company

#### Heating & Cooling

**Cooling Towers.....**Counterflow Cooling Tower Bul. 4.9.080A is available with information on operation, capacity & a wide variety of factors influencing performance. 31 \*J. F. Pritchard & Co.

**Heat Exchangers.....**Bulletin G-560 gives a complete description of the manufacturer's new Superplate heat exchangers. Schematic drawings, installation, etc. 211D Cherry-Burrell Corp.

**Heat Exchangers.....**The Polybloc impervious graphite heat exchanger is outlined in Engineering Manual PB-EM102. Includes illustrations, design data & other products. 211E The Carbone Corporation

**Heat Exchanger Equipment.....**The 162-page Condenser Tube Handbook answers problems, questions involving heat exchanger equipment. It is available now. 48 \*Bridgeport Brass Co.

**Heat Exchanger, Plate.....**for operating pressures as high as 175 psi. Heat transfer area is quickly changed by detachable plates. Easy cleaning & maintenance. 153 \*American Heat Reclaiming Corp.

**Heat Transfer.....**New Multi-Zone Platecoil provides a reserve of heating & cooling capacity for faster heat transfer. Bul. P61. 121-122 \*Tranter Mfg. Inc., Platecoil Div.

**Kilns, Rotary.....**Kiln shells are fabricated of quality steel plate. The main gear of a rotary kiln is made in halves & usually of cast steel. Bulletin #1115. 28 \*Traylor Engr. & Mfg. Co.

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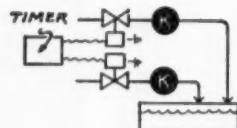
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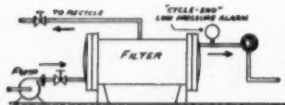
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**LITERATURE . . .**

**Steam Trap.**....combined with fine screen strainer makes a good team for steam. All the details are contained in the "Steam Trap" book that is offered.

L211 \*Yarnall-Waring Co.

**Steam Traps.**...."Balanced Pressure" Thermostatic steam traps cut trap maintenance costs & simplify parts inventory. This trap can't air-bind. Literature Kit 1A offered.

116 \*Sarco Company, Inc.

**Steam Traps.**....The 44-page book gives specific data on the selection & sizing of traps. Also information on design & construction of Inverted Bucket Steam Traps.

29 \*Armstrong Machine Works

**Vaporizers.**....All units, vertical or horizontal, are compact, self-contained, automatic heating plants. Catalog A-100 gives complete details on both types.

40 \*Eclipse Fuel Engineering Co.

**Water Chillers.**....Factory-Assembled packaged water chillers offer capacities from 18 to 300 tons. The panel mounted controls protect the system. Details.

155 \*York Corp.

## Instruments & Controls

**Comparators.**....Handbook, "Modern pH and Chlorine Control" gives the theory and application of pH control. Illustrates and describes the full line.

L217 \*W. A. Taylor & Co.

**Control Centers.**....Four-page brochure illustrates and describes typical custom control centers for all types of automation systems and automatic machinery.

212A Control Design

**Controllers, Pressure.**....The Wizard 11 is available in brass, steel or stainless steel Bourdon tubes for ranges from 25 to 10,000 psi. Details in Bulletin D 4150A.

113 \*Fisher Governor Co.

**Control, Liquid Level.**....available for controlling level changes from 1/8" to 150 ft. Multi-stage switching when desired. Detailed information is available.

TL225 \*Magnetrol Inc.

**Control, Temperature.**....The full story of low-cost temperature control is now available in Bulletin D-EC. Outlines the new self-powered regulator.

186 \*Fulton Syphon Div.

**Controls.**....Information on controls service including transmitters. The Libratrol-500 digital computer, data-processing systems & valve actuators is available.

171 G P E Controls, Inc.

**Controls.**....Microsen Electronic Process Controls instantly transmit accurate measurements over long distances... assure process stability & efficiency.

14-15 \*Manning, Maxwell & Moore, Inc.

**Differential Pressure Transmitter.**....

Supplement A of Bulletin WG-1824 describes a recently developed differential pressure transmitter. Operation, applications, etc

212B Yarnall-Waring Co.

\* From advertisement, this issue



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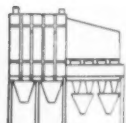
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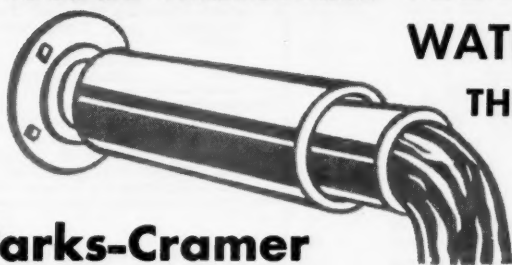
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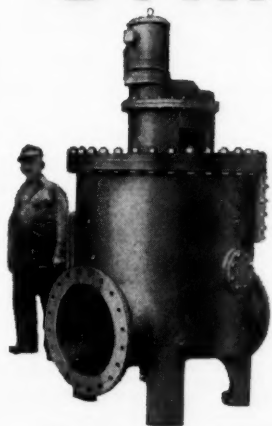
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218A Minneapolis-Honeywell
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SALES REPRESENTATIVES IN: Chicago, Ill.—Atlanta, Ga.—Houston, Tex.—Detroit, Mich.  
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FILTER PRESSES • VERTICAL LEAF FILTERS • FILTER MEDIA  
HORIZONTAL PLATE FILTERS • CONTINUOUS THICKENERS  
SLAB FORMERS • DIAPHRAGM PUMPS • ELECTROLYTIC CELLS

# DAY

Pneumatic Conveying & Bulk Storage News

FROM *Feathers* TO STEEL CHIPS



no job is too delicate or too tough  
for DAY Air-line Conveying Systems

DAY air-line pneumatic conveying systems can handle hundreds of different products, efficiently and economically. That's why you find DAY equipment in a bedding plant conveying feathers . . . and in a machine shop moving steel chips. These totally different DAY air-line systems demonstrate the versatility and ability of DAY equipment to best serve your pneumatic conveying needs.

## Only DAY gives you all types of equipment and services

DAY not only provides high density (so called "fluidizing") systems and low density conveying systems but also can supply all types of accessory equipment including the finest bulk storage tanks. This undivided responsibility is your guarantee of efficient, proven, dependable equipment that's right for your plant!

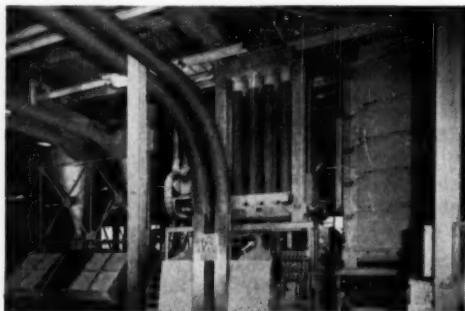


Vertical Bulk Storage Tanks



Horizontal Bulk Storage Tanks

Photo (below) shows DAY air-line pneumatic system which combines product drying and cooling with conveying. This system has been in successful operation for over 6 years.



Because no one type of conveying system fits all jobs it will pay you to study DAY BULLETIN M-588. It tells how to improve plant efficiency 6 ways and make substantial savings 9 ways with modern DAY air-line conveying systems. Write to DAY for free copy — BULLETIN M-588.

**The DAY Company**

SOLD in UNITED STATES by  
The DAY SALES Company  
856 Third Avenue N.E.  
Minneapolis 13, Minnesota



MADE and SOLD in CANADA by  
The DAY Company of Canada Limited  
Rexdale (Toronto), Ontario, Canada  
St. William, Ontario, Canada

Representatives in Principal Cities

**EQUIPMENT ONLY OR A COMPLETE SYSTEM**

## LITERATURE . . .

**Tubing, Stainless Steel.** . . . Welded stainless steel tubing resists corrosion, high temperature and contamination. Complete details on this tubing in Bul. 8591.

95 \*Formed Steel Tube Institute, Inc.

**Valves.** . . . All kinds & types available in a variety of Nickel & Monel. Able to handle every flow requirement. Information on all models is available.

85 \*The Wm. Powell Co.

**Valves, Control.** . . . for corrosive or non-corrosive flows . . . or other process flow conditions. Available in a wide range of types & sizes. New Catalog C800-1.

120 \*Minneapolis-Honeywell

**Valves, Diaphragm.** . . . Complete information on straightway or standard weir types, handwheel, lever, or power operated, is now available on request.

36 \*Grinnell Company, Inc.

**Valves, Gate.** . . . Aluminum alloy valves are now available in 1/2" through 24" sizes. Feature fully revolving double disc, parallel seat principle. Details offered.

112 \*Darling Valve & Mfg. Co.

**Valves, Gate.** . . . for high pressure corrosive service. Different designs for every size requirement. Bul. No. 7 gives complete information for specific corrosive service.

183 \*Alloy Steel Products Co.

**Valves, Knife Gate.** . . . available in a wide range of metal combinations & in several different styles. Handle corrosive chemicals. Details in Bulletin 300.

26 \*DeZurik Corporation

**Valves, Plug.** . . . may be installed in any position & they fit into the smallest possible space. Lubricated plug valves available for heavy fluids & ladings. Bulletins.

89 \*W-K-M Div. of ACF Industries

**Valves, Stainless Steel.** . . . A new catalog outlines patterns you want, in a choice of alloys that satisfy the requirements of practically all corrosive services.

99 \*Jenkins Bros.

**Valves & Fittings, PVC.** . . . All parts are made of plastic. Valves & fittings have high burst strength. Newest literature on the complete line is now available.

46 \*Walworth

**Weld Clamp.** . . . stops pin hole leaks or splits in welds on welded steel pipe lines. Each clamp is tested to 800 pounds line pressure. Details in catalog.

169 \*M. B. Skinner Co.

## Process Equipment

**Agitators.** . . . New bulletin provides details on side-drive agitators with stuffing boxes or mechanical seals. Cross sections and engineering drawings.

220A New England Tank & Tower

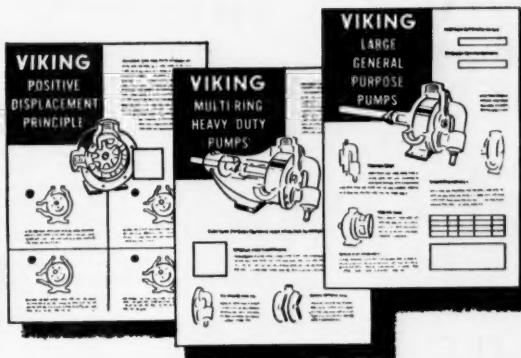
**Blenders.** . . . Ribbon blenders are available in capacities of 10 to 465 gallons. Complete information on blenders & mixers is contained in Bulletin 800.

191 \*The J. H. Day Co.

\* From advertisement, this issue.



# PUMPS ON YOUR MIND?



## Send for this VIKING Pump Data

### VIKING ENGINEERING DATA

A 36-page pump engineering manual is yours for the asking. It fully explains the 10 easy steps in selecting Viking rotary pumps. Ask for catalog KC.

### VIKING HEAVY DUTY PUMPS

Available in 10 to 1050 G.P.M. sizes, these rugged Vikings are suitable for pressures up to 200 PSI. Complete with specifications, performance data, etc., they are illustrated in the 24-page catalog CC.

### VIKING GENERAL PURPOSE PUMPS

These Viking Pumps—in  $\frac{1}{2}$  to 1050 G.P.M. sizes—are suitable for pressures up to 100 PSI. They are fully illustrated and have specifications, performance data, etc., in the 36-page catalog BC.

All Viking Pumps are positive displacement pumps and deliver either thin or thick liquids.

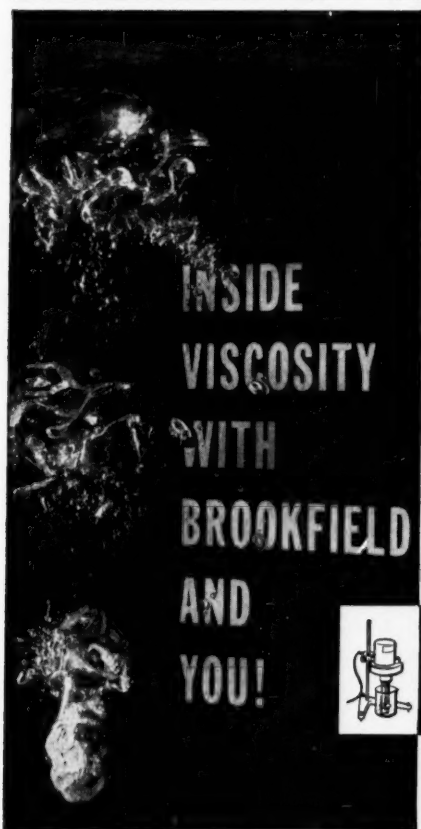
VIKING—the leader,  
not a follower,  
in Rotary Pumps



## VIKING PUMP COMPANY

Cedar Falls, Iowa, U.S.A. In Canada, it's "ROTO-XING" pumps

See Our Unit in Chemical Engineering Catalog



Right to the heart of this vital product dimension . . . that's where Brookfield can take you. Consider this an invitation to ask Brookfield to bring you up to date on how viscosity control, through Brookfield instrumentation, can be profitably applied to your processes. Viscosity measurement, recording and control can now be accomplished automatically for practically any fluid material. Low investment Brookfield portable and process-mounted instrumentation now plays a major role in practically every phase of chemical processing and research.

If Brookfield's long experience and coveted rheological know-how can be valuable to you, in-depth information is yours by writing—

World's Standard for Viscosity  
Measurement and Control

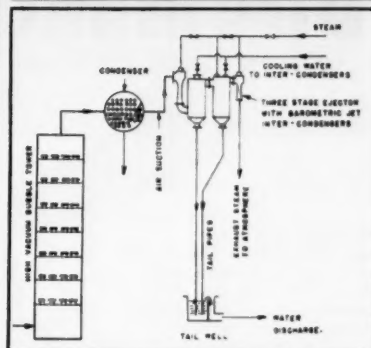


## Brookfield

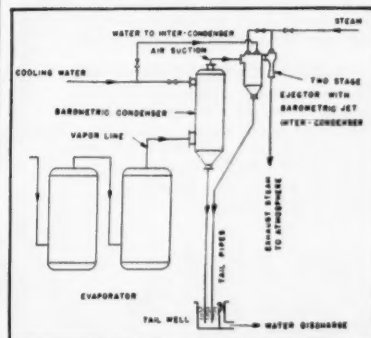
ENGINEERING LABORATORIES, INC.

Stoughton 13, Massachusetts

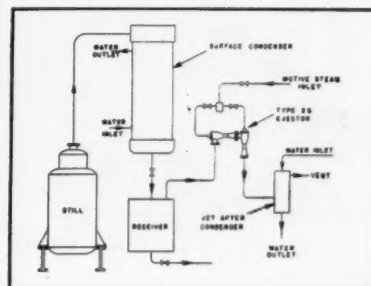
Here's how to get  
high vacuum  
at lower cost . . . from  
**C. H. WHEELER**



In Refining Operation—3-stage C.H. Wheeler Tubejet® Air Ejector draws off exceptionally large volumes of gases and vapors; produces high vacuum in bubble tower. Cost is low because Tubejets, with no moving parts, seldom need maintenance.



In Evaporation, Tubejet Ejector works with Wheeler Barometric Condenser to produce high vacuum. Initial cost of Ejector is low and installation is easy because of light weight and simple connections.



In Distilling—2-stage, non-condensing Tubejet produces high vacuum in the still. Note Wheeler Surface Condenser and Jet After-Condenser, too. Tubejets operate simply; have stainless steel, bronze and cast iron corrosion-resistant materials. Result: many Tubejets still operating after 35 years service!

FREE! 35-page catalog showing and describing many other ways to improve your vacuum operations and save money, too! Ask for Catalog 1462.

Process Equipment Division

## C. H. WHEELER MFG. CO.

19th and Lehigh Avenue • Philadelphia 32, Pa.  
Steam Jet Vacuum Equipment • Centrifugal, Axial and Mixed Flow Pumps  
Steam Condensers • Marine Auxiliary Machinery • Nuclear Products

world's smallest corral  
for 200 horses\*

(\*horsepower, that is)

...THE VAPOR HEATING CORPORATION

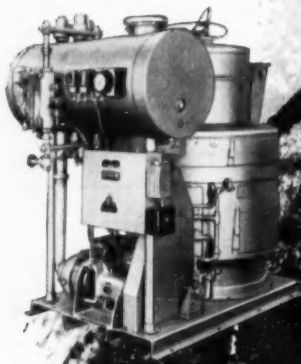
# DRUM MODULATIC

WATER TUBE BOILER—200 BHP in only 5' x 6'

Most heat and power packages let their horses run wild—spread them all over your plant...and that's mighty expensive range area. Vapor packs the same number of horses in about one-quarter the space of what old-fashioned boilers need. Even if you only valued inside area at \$20.00 a sq. ft., you'd save a whopping \$2400 on space alone. And you'd save plenty more on maintenance and long life...the simple fact is this:

## MODULATICS NEVER WEAR OUT

Ingenious design makes every part accessible—easily replaced should the need arise. And, Vapor guarantees their Modulatic coils 5 full years including up to \$50.00 labor allowance!  
SIZES: 20 to 200 HP...670,000 to 6,690,000 BTU per hr.



DEFERRED PAYMENT PLANS AVAILABLE IF YOUR CASH HAS OTHER WORK TO DO

## VAPOR HEATING CORPORATION

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Send me free literature: ☐ Drum Modulatic Bulletin 475;  
☐ Modulatics for pressures to 1000 psi, Bulletin 586;  
☐ Extended Payment Terms Bulletin 486; ☐ Hydrolatic Hot Water Boiler Bulletin 490.

Name

Address

City, Zone, State

## LITERATURE . . .

**Blenders.**.....Rotary Blenders start 4-way blending while charging, continue it during discharge, producing even blends of dry & semi dry materials. Bulletin 080B.  
R225 \*Sturtevant Mill Co.

**Clarifiers, Thickeners.**.....New 16-page bulletin describes three types of clarifiers and thickeners for handling liquid-solids separation in water, sewage and waste treatment.  
222A Inflico, Inc.

**Crushers & Pulverizers.**.....for reduction of every conceivable material in the chemical and allied industries. Complete information available.  
87 \*The Jeffrey Mfg. Co.

**Cyclone Separators.**.....Bulletin C-2058 covers the company's line of Type SDC Duclenes for catalyst recovery and other fluid bed operations. Illustrated.  
222B The Ducon Co., Inc.

**Deminerallizer.**.....produces demineralized water at flow rate of 2500 G.P.H. Details on mixed-bed, single-bed, two-bed & four-bed models in Catalog 127-A.  
60a \*Barnstead Still & Sterilizer

**Dryers.**.....A complete line that includes atmospheric and vacuum types, with chamber, pan, rotary, spray & other models. Catalogs 384 and 381 are available.  
57 \*Blaw-Knox Co.

**Ejectors.**.....Available literature on single-stage, multistage & corrosion-resisting types illustrates design & construction for chem. & indust. process applications.  
188 \*Elliott Co.

**Filter Air.**.....Construction and operating characteristics of the new Model B Roll-O-Matic automatic renewable-media air filter are the topics of a new bulletin.  
222C American Air Filter Co.

**Filters.**.....Two-color brochure covers product and property data on line of new industrial filters for corrosive liquids, gas diffusion, etc. Text, photographs, charts.  
222D Corning Glass Works

**Filters.**.....Fulflo filters, with genuine Honey-Comb filter tubes, provide continuous microclarity for all types of industrial fluids. Technical literature offered.  
24 \*Commercial Filters Corp.

**Filters.**.....offer safe, effective filtering protection for your equipment. Available in a wide range of types & sizes. Descriptive literature offered.  
224 \*Wm. W. Nugent & Co., Inc.

**Filters, Pressure Leaf.**.....Bulletin No. 146 outlines the horizontal tank, vertical leaf filters and the vertical tank, vertical leaf filters. Send for your copy.  
219 \*T. Shriver & Company, Inc.

**Floats.**.....for any liquid, for high pressures and for high temperatures. Catalog offers complete technical data on various types, sizes of floats, etc.  
TL237 \*Arthur Harris & Company

**Generator, Inert Gas.**.....Units are supplied as complete packages & include all controls & safety equip. Detailed information is contained in Bulletin #114.

218 \*Thermal Research & Engineering

\* From advertisement, this issue.

**Gyratory Crushers**.....New bulletin describes 10 sizes of gearless gyratory reduction crushers varying in capacity from 1 to 950 tons/hr. Details of drive, cavity, etc.  
223A Kennedy Van Saun

**High Vacuum Equipment**.....A 35-page catalog showing and describing many ways to improve your vacuum operations is now available on request. Catalog 1462.  
L221 \*C. H. Wheeler Mfg. Co.

**Magnetic Separator**.....A high-intensity magnetic separator of the induced roll type is described in new bulletin that also lists over 100 minerals & magnetic properties.  
223B Stearns Magnetic Products

**Mills, Impact**.....New bulletin tells most efficient method of achieving particle size reduction by centrifugal force. Mills available in all sizes to meet requirements.  
223C Safety Industries, Entoleter Div.

**Mist Eliminators**.....Bulletin ME-9 describes the latest advances in the technology of mist elimination. Data on mesh and grid construction, vapor velocity graphs.  
223D Metal Textile Corp.

**Mixer**.....The Turbulizer provides homogeneous mix. Sanitary, quick disconnect seals on each end of the shaft prevent foreign material from contaminating mix.  
103 \*The Strong Scott Mfg. Co.

**Mixers**.....A full line . . . side drive, tank top, portable or tripod & continuous pipeline mixers etc. For all your fluid mixing needs, Bulletin 582.  
167 \*New England Tank & Tower Co.

**Mixers**.....Bulletin 730 discusses the theory of mixing and compares the range of operations of different types of mixing equipment. Also has selection tables.  
223E Inflico Inc.

**Mixers, Centrifugal**.....Available in all sizes to meet individual requirements. Bulletin outlines new principle of high speed mixing producing intimate dispersion.  
223F Safety Industries, Entoleter Div.

**Precipitators**.....A 22-page booklet gives full information on SF electric precipitators. Feature low installation & maintenance cost in dust collection systems.  
216 \*Buell Engineering Co., Inc.

**Process Equipment**.....New 48-page catalog includes information on distillation, evaporation, drying, crystallization, extraction, heat transfer and absorption equipment.  
223G Acme Copper-smithing

**Process Equipment**.....Entitled "A Presentation of Facilities," a new booklet presents a customer-oriented view of the manufacturer's factories.  
223H The Pfadler Co.

**Process Equipment**.....Booklet entitled "59 Ideas for Modernization in '59" covers manufacturer's equipment line in answer to criteria for updating operations.  
223I Allis-Chalmers

**Reversible Impactor**.....for secondary grinding. Features 100% impact reduction, no friction or abrasion, unobstructed discharge, etc. Details.  
117 \*Williams Patent Crusher & Pulverizer

\* From advertisement, this issue.

## THE CORROSION-FREE WAY to handle chemicals



### MUELLER BRASS CO. **PVC** (POLYVINYL CHLORIDE) RIGID PLASTIC PIPE AND FITTINGS



The answer to most chemical corrosion problems can be found in an installation of Mueller Brass Co. PVC rigid plastic pipe and fittings. PVC pipe has proven itself invaluable to the chemical industry because of its high resistance to corrosion. Water, oil, gases, alkaline or salt solutions, alcohol and a wide variety of acids have no deteriorating effects upon PVC. Its extremely smooth interior bore eliminates pipe clogging and fouling and assures continuous maximum flow capacity. PVC is exceptionally strong, retaining its dimensional stability under stress, impact and moderately high temperatures. Mueller Brass PVC's life long built-in finish reduces maintenance costs and completely eliminates the need for painting or other protective coating. It is light and can be easily joined by threading or solvent cement, thus saving on installation time and expense.

For more efficient, economical and corrosion-free systems, specify Mueller Brass Co. PVC plastic pipe and fittings.



**NORMAL IMPACT PVC**—good impact strength . . . maximum chemical resistance.

**HIGH IMPACT PVC** — maximum impact strength . . . high chemical resistance.

Pipe is fabricated in 20' lengths; 1/2" through 3" sizes—I.P.S. schedules 40 and 80. Fittings are available in 1/2" through 3" sizes; threaded and socket-type for schedule 80 and in socket-type only for schedule 40.

Write for the new  
Mueller Brass Co. Technical Brochure.

## MUELLER BRASS CO.

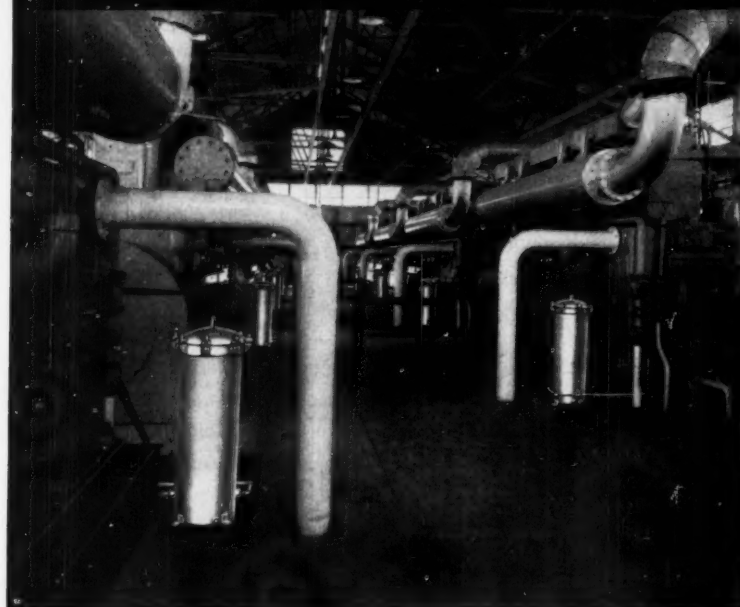
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274-A

POLYETHYLENE PIPE AND PLASTIC FITTINGS, COPPER TUBE, VALVES AND FITTINGS

# NUGENT FILTERS

Keep Lube Oil Clean  
for El Paso Natural Gas Company



Twenty-seven gas engine compressor units, each equipped with a Nugent Lube Oil Filter, have been in service at the Goldsmith plant of El Paso Natural Gas Company since 1949.

Excellent bearing, ring and cylinder wear maintenance records are positive proof that Nugent Filters have performed an outstanding job in keeping lube oil clean . . . free from sludge, acidity and harmful impurities that can accelerate wear and shorten engine life.

For safe, effective filtering protection for your valuable equipment . . . always specify Nugent Fuel and Lube Oil Filters . . . available in a wide range of types and sizes. Write for descriptive literature.



REPRESENTATIVES IN  
PRINCIPAL CITIES

**WM. W. NUGENT & CO., INC.**

3458 CLEVELAND STREET, SKOKIE, ILLINOIS

OIL FILTERS • STRAINERS • TELESCOPIC OILERS  
OILING AND FILTERING SYSTEMS • OILING DEVICES  
SIGHT FEED VALVES • FLOW INDICATORS

## LITERATURE . . .

**Roller Mills** . . . . .for pulverizing an extremely wide range of products & to handle various types of raw materials from mines, pits, quarries, etc. Catalog No. 79.

130 \*Combustion Engr. Raymond Div.

**Roller Mills** . . . . .Technical bulletin describes one, two, three-pair high and double roller mills. Full explanation of construction and design details.

224A Sprout, Waldron & Co.

**Screens, Vibrating** . . . . .Important new design, compact, high capacities, low power requirements for long life under rugged conditions. Bulletin offered.

224B Safety Industries, Entoleter Div.

**Scrubber, Wet Bed** . . . . .The "Cyclon-alre" is available in four sizes with rated capacities of 750, 1650, 3500 & 6000 cfm. Full technical data in Bul. FW-10.

66 \*U. S. Stoneware

**Transistor Washer** . . . . .for washing transistors, diodes, rectifiers, tube parts in ultra pure 15,000,000 O H M water. Full details in Bulletin #146.

60b \*Barnstead Still & Sterilizer

## Pumps, Blowers, Compressors

**Air-Conditioning System** . . . . .Kathabar systems maintain spaces at 80F & 55%RH, or lower, for processing, storage & testing. For use in various industries.

54 \*Surface Combustion Corp.

**Blower** . . . . .New R-C type RAS available in 36 sizes. Capacities range from 2,000 to 14,000 cfm at pressures to 6 psig & 15,000 to 8,000 cfm pressures to 10 psig. Bul. RAS-158.

55 \*Roots-Connersville Blower

**Compressors** . . . . .Bulletin describes non-lubricated compressors for oil-free compressed air. Compact enough to fit into a small space. Bulletin 130-11.

7 \*Joy Mfg. Co.

**Compressors** . . . . .Ro-Flo compressors available in 2-stage units from 250 to 1800 cfm and single-stage units from 40 to 3000 cfm. Descriptive literature is offered.

63 \*Allis-Chalmers

**Exhausters, Cast Iron** . . . . .are available with direct motor drive, separate belt drive or package unit with adjustable V-belt drive & motor. Full information.

185b \*Buffalo Forge Co.

**Fans** . . . . .Resin-bonded fiber glass fume fans are corrosion-resistant, impact-resistant & won't support combustion. Details including chem. resistance tables.

223B Stearns Magnetic Products

**Fans Axial Flow** . . . . .Application guide for various types of centrifugal and axial-flow fans is presented in new literature. Units for corrosion resistance.

224C Sturtevant Div.

**Fans Plastic** . . . . .Two new bulletins deal with two lines of corrosion-proof rigid plastic fans, one a centrifugal and the other known as a twin-flow. Made of PVC.

224D Atlas Mineral

\* From advertisement, this issue.



**permanent  
magnetic  
force...**



A sleeve, raised and lowered within a nonmagnetic tube, attracts or releases an Alnico magnet attached to the mercury (or dry contact) switch. Basically, this is Magnetrol.



**The operating principle  
behind *MAGNETROL*  
LIQUID LEVEL CONTROL**

Because its operating principle, based on the proper use of a permanent magnet, guarantees a perpetual guardianship over your critical liquid levels, the Magnetrol liquid level control unobtrusively takes the most important place in any system or process where it is necessary to keep a liquid at a constant level. Principle and action are so simple that failure is virtually impossible. Magnetrol is versatile, too—will handle almost ANY liquid, at ANY temperature, at ANY pressure, with the same precision and dependability. No mechanical or electrical linkages to stick, bind, ride out of line or wear out. Available for controlling level changes from 1/8" to 150 ft. Multi-stage switching when desired. Write to

**MAGNETROL, Inc., 2124 S. Marshall Blvd., Chicago 23, Illinois**

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ARE COST-CONSCIOUS  
PEOPLE***

On their own they spend a buck as freely as the next guy... but on the job chemical engineers regard the \$ as the most important engineering unit. Their eyes always search for less costly, more effective processing methods.

**THAT'S WHY**

Since 1947 *CHEMICAL ENGINEERING* has published over 125 articles... more than 500 pages... on costs, cost estimation, and engineering economics.

**THAT'S WHY**

Along with the editorial pages, *CHEMICAL ENGINEERING's* advertising pages form the chemical engineer's supermarket for chemicals, equipment and services needed by the CPI.

**THAT'S WHY**

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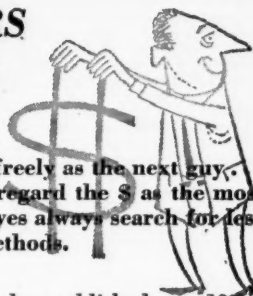
**THAT'S WHY**

*CHEMICAL ENGINEERING* is by far the most widely-read, most preferred magazine among chemical engineers. More engineers subscribe to *CHEMICAL ENGINEERING* than to any other magazine in its field.

*Chemical Engineering*

McGraw-Hill Building, New York 36, N. Y.

Published every other monday for Chemical Engineers in all functions



**Highly Intimate Blends  
in 1 to 2 Minutes**

**Blends while discharging;  
No segregation or flotation**

Sturtevant Rotary Blenders start 4-way blending while charging, continue it during discharge, thus producing highly intimate, even blends of dry and semi-dry materials — within 3 to 5 minutes of start of charging.

Six complete blending cycles per hour are common. And Sturtevant's special action produces no particle reduction, cleavage or attritional heat — is highly effective yet gentle and safe even with explosives.



Receiving

Scoops cascade material as drum rotates. Movement forces material from both ends to middle. Thus blending is 4-way right from start of charging.

Discharging

Single gate controls charge, discharge. Blending continues throughout discharge phase. Result is no segregation or flotation — highly intimate, even blends.



**Self-cleaning, dust-sealed drum;  
one-man accessibility**

Operation of Sturtevant Blenders is self-cleaning — drum interiors are completely dust-sealed. For inspection of all models, one man simply loosens a few lugs to remove manhole cover — quickly and easily.

**Nine standard models with  
capacities to 900 cu. ft.**



10 cu. ft. Sturtevant Blender at U.S. Steel Corp.'s new Applied Research Laboratory (Raw Materials Division) in Monroeville, Pa. This unit handles batches up to 500 lbs. — is ideal for pilot work and small runs.



One of four 450 cu. ft. Sturtevant Blenders at Celriver Plant of Celanese Corp. (Rock Hill, N. C.). These large units handle up to 20,000 lbs. batches — have a 9-year record of meeting the most exacting blending requirements.

**Fully or semi-automatic, or  
manually controlled operation**

Constructed of carbon steel, stainless steel or Monel metal, Sturtevant Rotary Blenders are engineered to fit each customer's needs — can be supplied with injector sprays and any desired control system.

For more on Sturtevant Blenders, request Bulletin No. 080B. (Bulletins also available on Mixers, Air Separators, Micronizers, Crushers and Grinders.) Write today. STURTEVANT MILL CO., 100 Clayton St., Boston, Mass.

# CHEMPRO makes them all in Teflon!\*

RING TYPE PACKINGS

ASBESTOS PACKINGS

V-TYPE PACKINGS

FLEXIBLE SEAL CAGES

JACKETED GASKETS

SOLID RING GASKETS

\*duPont trademark

**CHEMICAL & POWER PRODUCTS, INC.**  
5 Broadway, New York 4, N.Y.

Check the Bulletins you want:

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- ☐ Gaskets
- ☐ Teflon Stock & Special Molded and Machined Parts

Name \_\_\_\_\_

Company \_\_\_\_\_

Street \_\_\_\_\_

City \_\_\_\_\_

State \_\_\_\_\_

## LITERATURE . . .

**Pump**.....Bulletin 440 outlines typical applications, flow charts, description & specifications of Pulsafeeder models of various capacities & construction.  
53 \*Lapp Insulator Co., Inc.

**Pump**.....Moynos can pump any chemical, whether a thin watery slurry or an extremely viscous material. Discharge is uniform, non-pulsating. Bulletin 30-CE.  
119 \*Robbins & Myers, Inc.

**Pumps**.....Bulletin No. 1535 presents a discussion of how the general purpose Internal Gear Rotary Pump works, and how it is constructed. Applications included.  
226A The Deming Co.

**Pumps**.....All types & sizes of the Compacunit pump are covered in Bulletin 242. Special features and a Composite Rating Table are also included in this booklet.  
226B Warren Pumps, Inc.

**Pumps Centrifugal**.....Bulletin G-567 details advantages of Flexflo pumps' sanitation, heavier construction, better gasketing and new motor. Many sizes.  
226C Cherry-Burrell Corp.

**Pump Gear**.....Bulletin 1550 presents typical application data, specifications on a new line of heavy-duty internal gear rotary pumps. Operating conditions table.  
226D The Deming Co.

**Pumps, Horizontal Triplex**.....handle large volume of all types & densities of fluids. Capacities from 50 to 6500 GPH . . . pressures from 150 to 12,000 psi. Bul. P-55.  
192 \*Manton Gaulin Mfg. Co.

**Pumps, Motor**.....are available in a wide range of sizes & types. Capacities go from 5 to 2800 gal. per minute; heads to 650 ft. A new bulletin is offered.  
234 \*Ingersoll-Rand

**Pumps**.....Vertical pump, for molten chemicals. Horizontal pump, handles black liquor, caustic, etc., in evaporator service or transfers under vacuum. Bul. V-837.  
R208 \*Taber Pump Co.

## Services, Processes, Misc.

**Chromatographic Columns**.....18 p. data sheet GC-90-MI list the characteristics of 22 chromatographic columns along with their important applications.  
226E Beckman

**Cleaning, Mechanized**.....12 p. booklet describes the equipment available to accommodate mechanized application of various cleaning solutions.  
226F Oakite Products, Inc.

**Copymaker**....The Auto-Stat copy-maker offers "speed-feed" features. A new book contains illustrations & facts that point out its applications and advantages.  
109 \*American Photocopy Equip. Co.

**Cryogenics**.....New 12-page brochure covers, in text and pictures, subjects pertaining to cryogenics, nuclear engineering and ground support facilities.  
226B Stearns-Roger Mfg. Co.

\* From advertisement, this issue



# HIGH PRESSURE GAUGES

USED IN  
REFINERIES  
AND  
CHEMICAL PLANTS  
THROUGHOUT  
THE WORLD



THRU VISION



REFLEX  
Single or Multiple  
Sections

TUBULAR

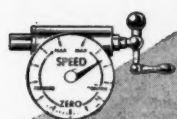
Gauge Cocks  
Large Chamber  
Reflex Gauges  
Heated or Cooled  
Gauges

SEND FOR  
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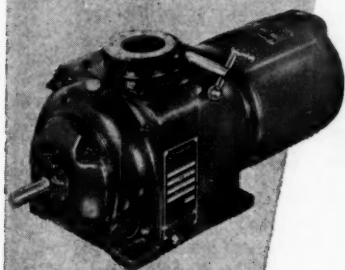
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- 2—Nickel clad evaporators, 400 & 250 sq. ft. vert. long tube
- 1—Stokes evaporator, 236 sq. ft., double effect, T316 SS
- 2—Bullovak evaporators, 250, 20 sq. ft., forced circulation, T304 SS, 1953
- 1—Struthers-Wells evaporator, 625 sq. ft., T347 SS, full vacuum
- 3—Sanitary Vacuum Pans, 6' dia. SS, internal coils
- 1—B & S evaporating kettle, 600 gal. SS, 6' dia. agit.

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- 3—Sparkler #33-S-28, T304 SS, 151 sq. ft.
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- 1—Niagara #80-30, T304 SS, 80 sq. ft., jacketed
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- 2—Kux #25 rotary
- 1—Kux #64, single punch

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- 4—Bird 24" x 24", monel, type CH
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- 1—BIRD 32" x 50", T316 SS, HORIZ.
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- 1—Baker-Perkins "Teer Meer" #HS-10, T316 SS.

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- 4—A-C 7' x 24' compeb, 450 HP
- 4—A-C 5' x 22' ball-tube, 150 HP
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- 1—A-C 6' x 16' ball, 30 HP
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- 2—7'6" x 100', 1/2" shell, 3-tire
- 2—6' x 60' Vulcan, 3/4" shell
- 1—4' x 24', 2-tire

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- 1—Fletcher 30" susp., T304 SS, Perf.
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- 3—Louisville stainless steel rotary dryers, 8' x 50'

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- 1—Bullovak double drum dryer, 42" x 120"
- 1—Stokes Model 59DS steel rotary vacuum dryer, 5' x 30'
- 1—Stokes double drum dryer, 5' x 12'
- 1—Louisville rotary steam tube dryer, 8' x 45'
- 1—Louisville SS rotary kiln, 30" x 28", complete
- 1—Stokes SS rotary vacuum dryer, 2' x 6'
- 6—Stokes steel jacketed rotary vacuum dryers, 3' x 15'
- 1—Stokes SS rotary vacuum dryers, 3' x 15'

## FILTERS

- 1—Oliver horizontal filter, 6'6"
- 1—Sweetland #3 SS filter
- 1—Niagara SS filter Model 510-28
- 1—Oliver horizontal filter, 3'
- 1—Feinc SS rotary vacuum string filter, 3' x 3' (NEW)
- 10—Shriver plate and frame filter presses, 12" to 42"
- 1—Shriver rubber lined filter press, 36" x 36"
- 12—Sweetland #12 Filters with 72 SS leaves

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- 3—Robinson type 316 SS sigma type jacketed heavy duty mixers, 300 gal. cap. 60 HP
- 3—Howes 40 cu. ft. rubber covered ribbon blenders
- 1—Leader SS jacketed 51 cu. ft ribbon blender

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- 1—Downington Iron steel bubble cap column 24" dia. with 14 trays
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- 6—Struthers Wells heat exchangers, 885 sq. ft.
- 1—Patterson Kelley steel heat exchanger, 427 sq. ft.
- 50—Steel heat exchangers from 15 sq. ft. to 400 sq. ft.
- 30—Struthers Wells SS heat exchangers, 650 sq. ft. each
- 1—Struthers Wells type 316 SS heat exchanger, 330 sq. ft.
- 2—Stokes tablet presses, Model T
- 1—Badger type 316 SS bubble cap column, 36" dia. with 8 trays
- 1—Badger type 316 SS bubble cap column, 42" dia. with 11 trays
- 1—Stokes Model DDS2 rotary tablet press
- 1—Struthers Wells SS calandria type evaporator, 365 sq. ft.
- 1—Swenson single effect evaporator, SS, 320 sq. ft.
- 1—Swenson type 316 SS vacuum crystallizer, 3'6" x 12'
- 1—Swenson type 316 SS vacuum crystallizer, 2'6" x 12'
- 6—Davis Eng. type 316 SS heat exchangers, 170 sq. ft. (NEW)
- 1—Vulcan type 347 SS bubble cap column, 4' dia. x 35', 30 trays
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- 2—Blaw-Knox steel distillation columns, 36" x 40' with 24 trays complete (NEW)

- 3—Pfaudler type 316 jacketed reactors, 750 gal.
- 2—Pfaudler type 316 SS jacketed kettles, 400 gal.
- 2—Van Alst SS jacketed kettles, 400 gal.
- 2—Van Alst SS jacketed reactors, 50 gal.

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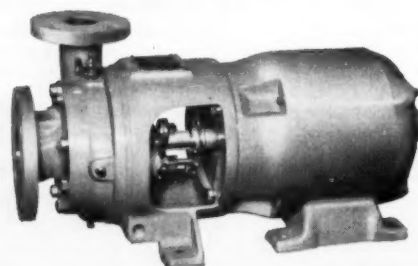
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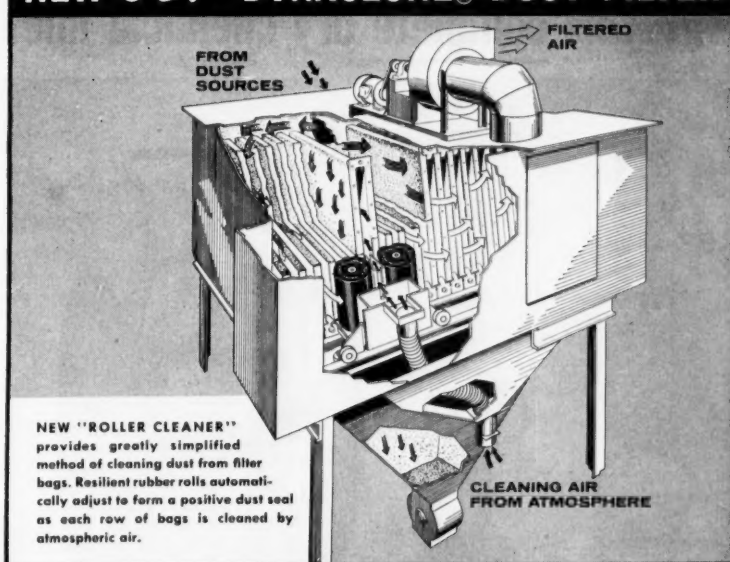
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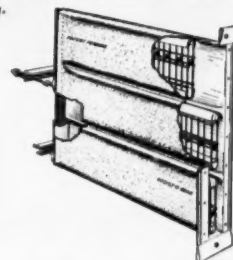
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## NEW SLY DYNACLONE® DUST FILTER



Patent Nos. 2583039, 2695681, 2867289. Other Patents Pending.

## NOW! As Much As 3 TIMES LONGER FILTER BAG LIFE



**NEW SLY "RESIST-O-WEAR" FILTER BAGS** (patent pending) provide complete dust filtration with as much as three times longer life than conventional bags. This has been proved on the toughest field installations.

The new bag has three equal-size sections. Each pocket has two spacers, making a total of six per bag. Weight is distributed on

three seams rather than one, minimizing strain. A special protective flap on the back end prevents abrasion from incoming dust.

Now standard in the new "Roll-Clean" Dynaclone, Sly "Resist-O-Wear" bags combine with all the other superior Dynaclone features to assure greatest dust collecting efficiency with unequalled maintenance-free service.

### ALL THESE FEATURES IN ONE DUST FILTER

- New "Resist-O-Wear" bags last as much as three times longer.
- Free-rolling cleaner. Complete dust seal—automatic seal adjustment.
- Constant suction at dust sources—complete dust collection.
- Greater filtering capacity; smaller space requirements.
- Automatically self-cleaning for continuous operation.
- Simplified construction for ease of inspection and servicing.

SEND FOR New Bulletin 105 and  
New 36-page Dust Control Catalog 104.



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The 200-pound Kidde pressurized wheeled unit discharges a 40-foot dry chemical stream faster, has an *extra* 50 pounds of fire-smothering dry chemical to knock down fire quicker. It's faster and easier to operate... just remove pin, swing toggle lever, and flip on-off lever. Easy to maneuver because of its low center of gravity and larger wheels. Truly a one-man fire engine!

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accepted; agreeable; welcom  
a-ble-ness, n. — ac-cept'i  
ac-cept'ance (-tāns), n. (r  
reception; approval. 2. S  
ableness. 3. Com. a An  
whom a bill of exchange is d  
stated. b An accepted bill,  
ance, a bank acceptance. 4  
conduct, to the act or offer  
and the parties become bou  
ac-cept'an-cy (-tān-sī), n. 1  
ac-cept'ant (-tānt), adj. Ac  
ac-cept'ed (ik-sēp'tēd), v. t.  
the meaning in which a v  
ac-cept'ed. — Syn. See 1  
as a bill of exchange. 2. One who  
ac-cept'ed (ik-sēp'tēd; -tōr), n.  
who accepts a bill  
accede. See ACCEDE.] 1.  
cessibility; as to not

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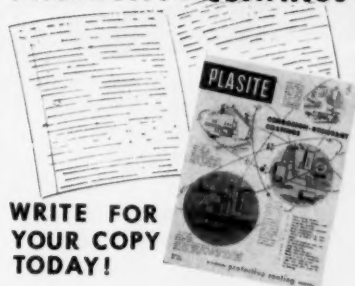


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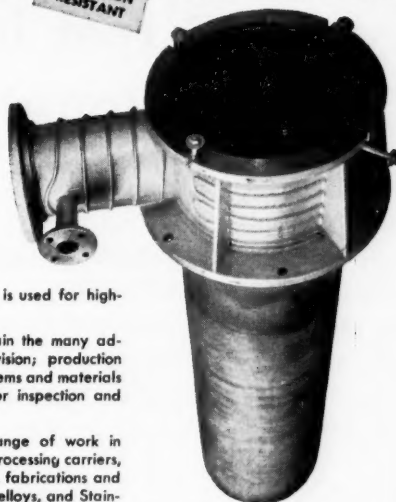
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RETORTS**



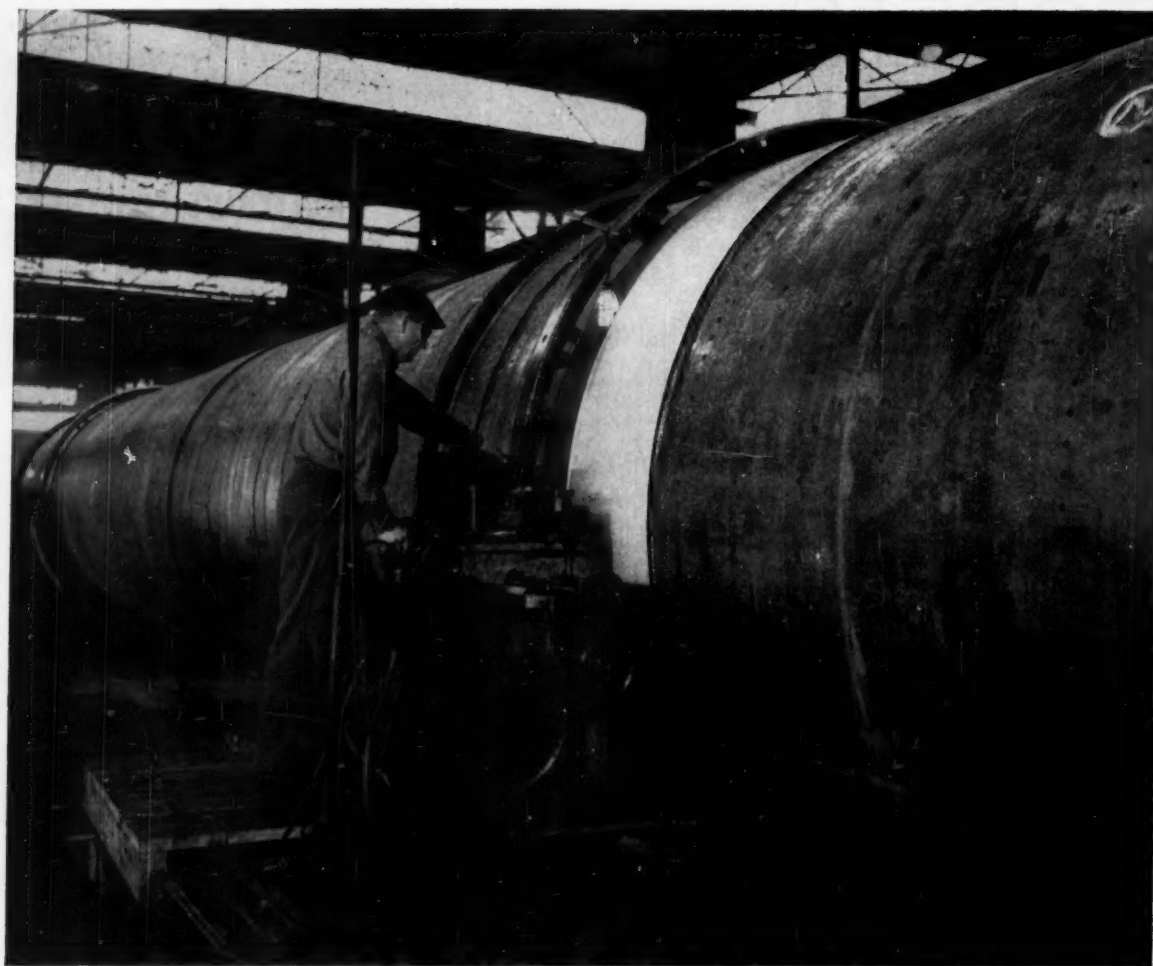
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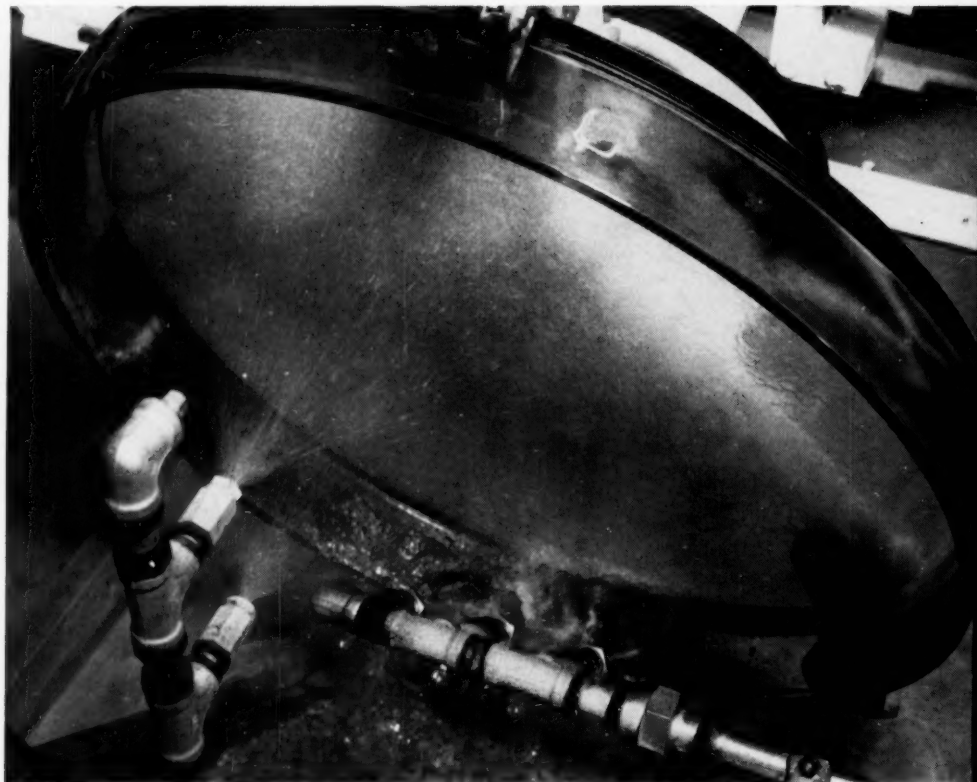
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